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SCIENTIFIC PAPERS.

A REVISION OF THE NORTH AMERICAN SPECIES OF SAGITTARIA AND LOPHOTOCARPUS.

BY JARED G. SMITH.

The principal published revisions of the Alismaceae are those of Engelmann,* Buchenau,† and Micheli.‡ The present revision has been based on a study of the material contained in the Engelmann and general herbaria of the Botanical Garden, and in the herbaria of the Shaw School of Botany, Harvard University, the United States Department of Agriculture, Columbia College, the University of Nebraska, Kansas Agricultural College, the University of Minnesota, and in the private herbaria of Mr. Walter Deane, Dr. Charles Mohr, Mr. P. A. Rydberg, and Mr. Henry Eggert. My cordial thanks are also tendered to the many correspondents who have contributed specimens to the Garden Herbarium. I have been especially aided in this work by and am largely indebted to the many and copious manuscript notes and drawings made by Dr. George Engelmann during his life-long study of these genera. Not only

* Dr. George Engelmann, in A. Gray, *Man.* (1848); *Ed. 2* (1856); *Ed. 5* (1867). For complete references see *The Botanical Works of George Engelmann, Collected for Henry Shaw*, 496 (1887).

† Franz Buchenau, *Index Criticus Butomacearum, Alismacearum Juncaginacearumque hujusque descriptorum*, in *Abh. Nat. Ver. Bremen* (1868).—*Nachtraege zu den kritischen Zusammenstellungen der bis jetzt beschriebenen Butomaceen, Alismaceen und Juncaginaceen*, Bremen, (1871).—*Beitraege zur Kenntniss der Butomaceen, Alismaceen und Juncaginaceen*, in *Engler, Bot. Jahrb. 2: Heft 5* (1882).—In *Engler und Prantl, Die Natürlichen Pflanzenfamilien 2: 1, 227* (1889).

‡ Marc Micheli, in *DC. Monog. Phan. 3:29* (1881).

did Dr. Engelmann examine the material preserved in all of the principal American herbaria, but in his visits to Europe in 1856-7, and 1883, he studied the types and American collections preserved in the great English and Continental herbaria. These notes and the types in his own very rich herbarium have served as a foundation for the work undertaken.

I have followed Buchenau and Micheli in separating the species of *Lophotocarpus* from *Sagittaria*. *Lophotocarpus* is annual (at least our species), the flowers are perfect or staminate, and the stamens are hypogynous. *Sagittaria* is perennial, monoecious or dioecious with the fertile flowers never perfect, and the stamens are borne above the receptacle. The separation of *Lophotocarpus* simplifies the genus *Sagittaria* very much, reducing somewhat its cosmopolitan character. In their present form the genera more nearly express the genetic relationship.

Sagittaria is a genus consisting of from ten to thirty species, according as the ideas of the various monographers differ. A large part are American, the rest extending over Europe and Northern Asia. Of the twenty-two species which I have recognized in North America, one is only an introduced ballast plant, and one extends into Central and South America.

The American *S. latifolia*, together with the related species of the group *Sagittifoliae*, has been considered as falling within the limits of the widely distributed European and Asiatic *S. sagittifolia*. Micheli, in DC. Monog. Phan. 3: 66, 69, and, following him, a number of American systematists, have held this opinion. Dr. Engelmann, in A. Gray, Man. Ed. 2 (1856), first pointed out the differences which separate the two species. Buchenau, in Engler, Bot. Jahrb. 2: 486 (1882), supports this view that they are distinct. In this I have followed Engelmann and Buchenau. The two species occupy different geographical ranges and are isolated one from the other, although both undoubtedly derived from the same stock. The American species are

more closely related to the Asiatic than to the European forms of *sagittifolia*.

Classification according to leaf forms has proved very unsatisfactory. After examining nearly two thousand herbarium specimens, besides much living material, I have found that there is least variation in the form and size of the achenium, form of the anthers, pubescence or lack of pubescence of the filaments, relative length of fertile and sterile pedicels, and within certain limits in the form of the bracts. As in most aquatics, the leaves vary through wide limits in the same species, and characters founded on leaf differences, at least among the *Sagittifoliae*, are of little value. Some reliance, however, may be placed on the relative length of the lobes or divisions of the leaf, excepting always in the immature or phyllodial forms. The phyllodia themselves are too variable to be of much diagnostic value, though some of our more recent American systematists have endeavored to draw specific characters from them. Phyllodia are not always present. In some species they seem to offer wider differences than the leaves. They appear to be formed principally when conditions are unfavorable for the development of aerial leaves, and whether they are considered degraded leaf forms, or reversions to a previously existing type, the characters which they present have little specific value.

Intravaginal squamules as noted by Buchenau in Engler, Bot. Jahrb. 2: 467 (1882), are present in the Alismaceae and allied orders. They consist of from one to three rows of very delicate scales attached in the axils of the leaves to the dorsal edge of the petiole. They are linear-lanceolate, 2 to 4 mm. long, colorless, from one to three or four cells thick at the base. They may be easily studied on young plants of the common *S. latifolia*, and will probably be found in other species.

Many or possibly all of our North American Sagittarias, in common with the Old World species, form underground autumn tubers. These have been observed in *S. latifolia*,

S. graminea, *S. heterophylla*, *S. longiloba* and *S. papillosa*. Horizontal or oblique rhizomes are present in *S. lancifolia* and *S. graminea cycloptera*. The tubers of *latifolia*, *graminea* and *heterophylla*, are edible. They are used by the Indian tribes of the Northwest, and are called either Wappatoo, or Wabesipinig, the latter meaning Swan-potatoes, because of their furnishing food for the numerous wild-fowl of that region. The tubers are formed in the mud at the depth of 2 to 4 dm. In the spring they throw out a long rhizome which forms at its upper end a corm, and from this corm arise the roots and leaves.

The descriptions given in the following synopsis have been drawn as far as possible from herbarium specimens or the living plants. The exceptions were *Sagittaria lancifolia angustifolia* (Lindl.) Griseb., and *Lophotocarpus Guyanensis* (HBK.) Mich., both from Mexico. These were adapted from Micheli, because of the insufficiency of material in the herbaria examined.

Since contributing a list of the *Sagittarias* of the Eastern United States to the Mem. Torr. Bot. Club, Vol. 5: 25 (1894), I have examined fuller material of *S. graminea platyphylla*, and have thought best to raise the variety to specific rank.

The limited bibliography given includes the principal works used in the preparation of this paper. It was believed that its value as a systematic monograph would not be enhanced if the great mass of minor references were printed. I have endeavored to make the synonymy complete as far as original descriptions of American species are concerned. Buchenau and Micheli have given the fuller bibliography, and I will refer any who are interested in the study of these genera to their cited works. If deemed necessary, the more complete bibliography may be published at some future time.

SAGITTARIA L. Sp. Plant, 993 (1753).—Flowers all unisexual, but the staminate frequently with abortive pistils at center; filaments inserted above the receptacle.

ANALYTICAL KEY.

1. Sepals of the pistillate flower reflexed or spreading, not accrescent.
 * Fertile pedicels slender, ascending, neither much thickened nor reflexed in fruit.
- + Leaves sagittate; filaments glabrous, not dilated.
 ++ Basal lobes equaling or shorter than the middle one.
 = Beak more than one-fourth the length of the achenium.
 Fertile pedicels much shorter than the bracts; leaves ample;
 beak of the achenium stout, erect. *S. longirostra.*
 Fertile pedicels longer than the bracts; leaves with linear
 lobes; beak of the achenium erect. *S. Engelmanniana.*
 Beak of the achenium lateral, horizontal or oblique. *S. latifolia.*
 == Beak of the cuneate obovate achenium very short, erect, re-
 tortse; basal lobes very short.
 Petioles short and curving; bracts long, scarious margined;
 terrestrial, or emergent aquatic. *S. arifolia.*
 Petioles long and slender; bracts short; submerged aquatic
 with flowers at the surface of the water. *S. cuneata.*
- ++ ++ Basal lobes more than half the length of the leaf.
 Basal lobes 2 or 3 times as long as the middle one; stamens
 less than 24; seed coat punctate. *S. longiloba.*
 Basal lobes less than twice as long as the middle one; stamens
 30 or more; seed coat not punctate. *S. Greggii.*
- + + Leaves entire or hastate.
 ++ Filaments slender, not dilated; leaves pseudo-penninerved.
 Filaments glabrous; bracts short, densely papillose; achenium
 short-obovate. *S. papillosa.*
 Filaments glabrous; achenium falcate; fertile pedicels longer
 than the sterile. *S. ambigua.*
 Filaments cobwebby pubescent; achenium falcate. *S. lancifolia.*
- ++ ++ Filaments dilated, pubescent; veins free to the base of the leaf.
- a. Fertile flowers sessile; scape geniculate at the lowest verticil;
 achenium stoutly beaked. *S. rigida.*
- b. Fertile pedicels shorter than the sterile; achenium 3 mm. long,
 broadly winged, the sides smooth.—In South Carolina.
S. macrocarpa.
- c. Fertile pedicels about as long as the sterile.
 Leaves terete and mostly bladeless.—Species of the Atlantic
 coast. *S. teres.*
 Leaves rigid, elliptical-linear, somewhat triquetrous. *S. cristata.*
 Leaves neither rigid nor terete. *S. graminea.*
- ** Fertile pedicels much thickened, reflexed in fruit.
- a. Filaments dilated, pubescent. *S. platyphylla.*
- b. Filaments dilated, glabrous.
 Stamens 7 or 8.
 Scape simple. *S. subulata.*

- Scape branching, longer than the linear submerged leaves. *S. filiformis.*
- Stamens 12 or 13. *S. demersa.*
- c. Filaments slender, glabrous; leaves entire; achenia cuneate quadrate. *S. Sanfordii.*
- *** Fertile pedicels much thickened, ascending; filaments slender, glabrous; scape shorter than the leaves. *S. Mexicana.*
2. Sepals of the pistillate flower erect and accrescent; petals with a brownish purple spot at the base. *S. Montevidensis.*

SYNOPSIS OF THE SPECIES OF SAGITTARIA NORTH OF MEXICO.

A. Sepals of the pistillate flower reflexed after flowering, not enlarging in fruit; petals white.

§ *Sagittifoliae*. Leaves sagittate or rarely when submerged entire, or reduced to bladeless phyllodia; filaments glabrous, not enlarged at the base; sterile pedicels longer than the fertile.

* Achenium obovate cuneate, the beak minute, erect, retrorse; filaments shorter than or equaling the anthers; basal lobes less than half the length of the leaf; bracts slightly connate.

S. ARIFOLIA Nutt. in herb.— *S. sagittifolia minor* Pursh, Flora Amer. Sept. 2: 395 (1814).* *S. variabilis* var. *hastata* forms *b* and *c* in part, Macoun, Cat. Can. Pl., 4: 77, 78 (1888).

Terrestrial, or emergent aquatic, weak, ascending, 2 to 4 dm. high; petioles rather stout, usually curving outward; blade of leaf 6 to 12 or 18 cm. long, arrow-shaped, acute, the margin mostly straight or arcuate, basal lobes divergent, acute or acuminate; scape weak, ascending, simple or rarely branched; bracts lanceolate, acute, 8 to 20 mm. long, scarious margined and obscurely veined, often reflexed; 1 to 3 lower verticils pistillate; fertile pedicels ascending, 15 to mostly 25 mm. long, or sometimes almost wanting; fruiting head round, 8 to 15 mm. in diameter; achenium 2 mm. long, tumid winged on both margins, the

* Pursh gives the range as "Pennsylvania to Carolina;" but Dr. Engelmann in his manuscript notes says that Pursh's plant is from the Rocky Mountains and that it "seems to be exactly like" a specimen collected by Nuttall.

sides smooth, or often with a vertical subepidermal resin passage. Phyllodia of two forms, either long, slender, petiole-like, or flattened, linear-lanceolate, 2 to 5 dm. long and 10 to 15 mm. wide.— Along streams or sandy margins of lakes and ponds, in the mountains from British Columbia to California, Nevada and New Mexico, and from western Kansas and Nebraska to Minnesota and Quebec.

Phyllodial or immature specimens are difficult to distinguish from plants of *S. latifolia* form *c* of similar habit. The species perhaps approaches most closely the Northern European and Asiatic *S. sagittifolia*, from which, however, mature specimens are easily separated. The achenia are much smaller, and cunate-obovate instead of nearly orbicular as in the European species. — Plate 1.

Specimens examined from British Columbia (Macoun, Kamloops, 1879, and 1889, *S. variabilis hastata* form *c*, Sicamous, 1889); Washington (Dr. Lyall, 1860; Suksdorf, 1818, Sept. 1893, Klickitat Co.); Oregon (Kellogg and Harford, 952, 1869; Howell, Sauvies Island, 1887; Nuttall); California (Bolander, Sierras, 1870; Vasey, 1875; Mrs. Ames, 1876, Plumas Co.; Mrs. Austin, 1877); Nevada (Stevens, Pac. R. R. Surv.; Torrey, 506, 1865, Lake Washoe; Bailey, 1151, 1867, Truckee Valley; Palmer, 1876); Utah (S. Watson, 1151, 1869, Salt Lake Valley; Jones, 1071, Salt Lake City, 1879); Colorado (Jones, 1878, Denver); New Mexico (Wislizenus, 27 and 225, 1846, the latter with irregularly approximate whorls; Fendler, 837 and 839, 1847; Edwards, 1849, Santa Fé, the "*S. Mexicana*" of Herb. Torrey but not of Engelmann); Northwest Terr. (Parry; Macoun, 1751, 1879, Eagle Hills "*S. variabilis gracilis*", — Land Hills, "*S. variabilis hastata* form *b*", — and 1883, Moose Mountain Creek); Manitoba (Bourgeau, 1857, Winnipeg Valley); Idaho (Leiberg, 526, 1891, Lake Pend d'Oreille, "in water 3-12 dm. deep, or in simply wet places," "on sandbars, shallow bays and mouths of rivers, abundant," many forms); Montana (Notestein, 1893, Great Falls); Geyer, Nicollett's Northwest Expedition, 1839; S. Dakota (Williams, 16, 1892, Big Stone Lake and many other localities. Specimens from Big Stone Lake have branched scape with whorls irregularly approximate, lobes of leaf linear, much elongated, and two kinds of phyllodia on the same plant); Nebraska (H. Engelmann, Platte Bottoms, 1852, 1856 and 1858, the latter with bracts 25 to 30 mm. long; Smith and Pound, 235, 1892, Sand Hills; Bates, Sand Hills); Iowa (Hitchcock, 1891); Minnesota (Minneapolis, 1877, "N. H. W.," with broadly ovate leaves, submerged scape, the irregularly approximate fertile verticils each with 3 to 6 flowers; Bailey, 154, 1886, Vermillion Lake; Sandberg, 1179, 1891, Lake Itasca); Michigan (Davis, 1890, Alma; Kofoid, 1890 and 1891, Cheboygan Co., and "sandy margins of Black

Lake)'' ; Ontario (Macoun, 1884, Nipigon River, *S. variabilis hastata* form c). An immature specimen from Macoun, 1882, Grand Vallée, Gaspé, *S. variabilis hastata* form c, probably goes here.

S. ARIFOLIA STRICTA n. var.

Slender, erect, 3 to 4 dm. high; blade of leaf 2 to 5 cm. long; scape simple, erect; bracts ovate, acute, 6 to 8 mm. long; fertile pedicels 8 to 15 mm. long; fruiting head 1 cm. in diameter; achenium smooth or laterally uncostate.—Boggy meadows and slow streams, Falcon Valley, Washington, W. N. Suksdorf, 1319 (674), Aug. 1, 1885.—Plate 1.

S. CUNEATA Sheldon, Bull. Torr. Club, **20**: 283, pl. 159, (1893).

Submerged aquatic, rooting in the sand; leaves long petioled; blade floating, small, 5 to 8 cm. long, with linear lobes; scape simple, slender, terete, 6 to 9 dm. long, bearing verticils of flowers at the surface of the water; bracts ovate-lanceolate, acute, 4 to 6 mm. long; stamens few (?); fruiting head small, about 1 cm. in diameter; achenium 1 mm. long. Phyllodia of two forms, either linear attenuate, petiole-like, reaching nearly to the surface of the water, or lanceolate, 6 to 12 cm. long, 4 to 8 mm. wide, clustered at the base.—In shallow ponds, or margins of lakes, from British Columbia to Minnesota.—Plate 2.

Specimens examined from British Columbia (Dawson, Aug. 1888, Kamloops; Macoun, 1889, Sicamous); North West Territory (Macoun, 1751, 1879, Eagle Hills); Washington (Suksdorf, 2262, 1889, Philles Lake, Spokane Co.); South Dakota (Williams, 15, 1892, Big Stone Lake); Minnesota (Sheldon, 3576, East Battle Lake,—3925½, Blanche Lake,—3926½, Mollie Stark Lake, 1892).

* * Achenium obovate, the beak prominent, $\frac{1}{4}$ to $\frac{1}{2}$ as long as the ovary; filaments longer than the anthers; basal lobes not more than half the length of the leaf; bracts, at least of the lower verticils, free.

S. LATIFOLIA Willd. Sp. Pl. **4**: 409 (1806). *S. gracilis* Pursh, Fl. Am. Sept. 396 (1814). *S. simplex* Pursh, l. c., described from staminate scape, and leaf of *Rumex*. *S. variabilis* Engelm. in A. Gray, Man. 461

(1848). *S. sagittifolia* of Amer. authors, not Linn. *S. sagittifolia*, var. *variabilis* Micheli in DC. Monog. Phan. 3: 69 (1881), in part, not *S. longiloba* Engelm. *S. variabilis* var. *angustifolia* Engelm. in A. Gray, Man. Ed. 5, 493 (1867). *S. variabilis* var. *diversifolia*, Engelm. in A. Gray, Man. Ed. 5, 493 (1867). *S. variabilis* var. *gracilis* Engelm. in A. Gray, Man. Ed. 5, 493 (1867). *S. hastata* Pursh, l. c. *S. variabilis* var. *hastata* Engelm. in A. Gray, Man. Ed. 5, 493 (1867). *S. variabilis* var. *hastata* form *a*, and in part forms *b* and *c*, Macoun, Cat. Can. Pl. 4: 77, 78 (1888). *S. obtusa* Willd. Sp. Pl. 4: 409 (1806). *S. sagittifolia* var. *macrophylla*, and var. *vulgaris* Hooker Fl. Bor. Amer. 2: 167 (1840). *S. Chinensis* Parish, Zoe, 1: 122 (1890). *S. Sinensis* Brandege, Zoe, 4: 217 (1893), not Sims.

Monoecious, with the lower verticils fertile, or dioecious; scape 1 to 12 dm. high, angled, simple or branched; flowers large, 2 to 4 cm. wide, the petals white; stamens numerous, 25 to 35; fertile pedicels shorter than the sterile; bracts sometimes connate in the upper verticils, acute, acuminate, or obtuse, not scarious; achenium broadly winged on both margins, 2.5 to 3.5 or rarely 4 mm. long, with a lateral horizontal or curving beak $\frac{1}{4}$ to $\frac{1}{3}$ its length, sides usually smooth, or with a costate angle curving downward from the base of the beak, rarely with a subepidermal resin passage on each face.—An extremely variable species, extending from Nova Scotia to British Columbia, south along the Pacific Coast to California, and throughout the region east of the Rocky Mountains to Mexico and Florida.—Plates 3 to 7.

The species is a complex one on account of its wide geographical distribution and varying habitat. After an examination of nearly all the available material, the species seems best divided into forms instead of varieties, of which I recognize five. These merge into one another, so that it is difficult to draw hard and fast lines between them. The

first represents, as far as I am able to determine, the species in its most typical form.

S. latifolia proper.—Monoecious or subdioecious; large, erect, 3 to 6 dm. high; leaves longer than broad, glabrous or rarely pubescent, 15 to 40 cm. long, with lobes from broadly ovate, acute, to linear lanceolate, acute or acuminate; scape erect, simple or branched; bracts glabrous, acute or acuminate, 1 to 5 cm. long; verticils rarely approximate, mostly more than five; fertile pedicels 2 to 4 or sometimes 6 or 8 cm. long; fruiting head 15 to 30 mm. in diameter; achenium about 3 mm. long.—This is the common form from Massachusetts and New York west to Colorado, and south to Florida and Louisiana.

Specimens examined from Prince Edward Island (Macoun, 1888); Ontario (Macoun, 1884; Britton, 1889); Massachusetts (Deane); New York (Torrey; Morong); New Jersey (Dr. Gray, 1833; Bernhardt; Britton, 1889); Pennsylvania (Durand, 1848; Porter); Ohio (Riehl, 1838); S. Carolina (M. A. Curtis); Alabama (Mohr); Indiana (Case, 1878; S. Watson, 1890, Crawfordsville, has a branched scape with 6 lower whorls fertile, fruiting head 20 to 25 mm. in diameter on pedicels 15 to 20 mm. long, bracts 3 cm. long, acuminate, achenium crested, 2.5 mm. long, the beak oblique); Illinois (Engelmann and many collectors); Missouri, common; Michigan (Farwell, 729, 1889; Schneck, 1881; Davis, 1890); Minnesota (Sandberg, Red Wing, 1885, 622, 1891; Taylor, 907, 1891, Glenwood); Iowa, common; S. Dakota (Williams, 1892, numerous localities); Eastern Nebraska and Kansas, common; Colorado (Denver, Fritchey, 1886); Louisiana (Dr. Hale, specimens with ovate bracts 1 cm. long); Florida (Dr. Chapman, 1863, with the upper part of the petiole and the under surface of the leaves pubescent, fertile pedicels and acuminate bracts 1 cm. long, bracts and sepals glabrous).

This form includes a part of *communis*, and all of *acuta* and *subdioica* of the Engelmann Herbarium, and a part of Macoun's var. *hastata*, Cat. Can. Pl. l. c. The common form in Indiana, Illinois, Iowa and Missouri, has a dorsally crested obliquely beaked akene 2 to 2.5 mm. long, fertile pedicels 12 to 15 mm. long, shorter than the acuminate bracts. This passes into the form with longer (3 to 3.5 mm.) akenes with horizontal beaks. I am unable to separate them except geographically. The dorsally crested

form is confined to the Mississippi Valley. The horizontal beaked form is found throughout the range.

Two specimens in the Engelmann Herbarium have a bract of the lowest whorl foliaceous; that of a specimen collected in Iowa by Wood is linear-lanceolate, acute, falcate, 8 cm. long; the other, collected by Engelmann in St. Louis, is 45 cm. long. "Doubled" flowers in which the outer stamens become petaloid have been collected at Lancaster and Harrisburg, Pa., by Prof. Porter; at West Troy, N. Y., by Wibbe; and at Cooperstown, N. Y., by Miss Keyes, in 1886.

Form a. — Dioecious; leaves longer than broad, 15 to 30 cm. long, from ample, broadly ovate, obtuse, to linear lanceolate, gradually acuminate; scape simple or branched; bracts ovate, obtuse, 8 to 15 mm. long, glabrous. — From New Brunswick to Minnesota, Louisiana and South Carolina. It includes *S. obtusa* Willd., *S. variabilis obtusa*, Engelm., and *S. hastata* Pursh.

Specimens examined from New Brunswick (Macoun, 1876, Cambellton); Ontario (Macoun, 1873, Hastings Co.; 1877, Belleville; 1884, Nation River); New Hampshire (Deane, 1889); Connecticut (Eaton); New York (Torrey; Gray; Trelease); Pennsylvania (Canby); New Jersey; Delaware (Durand); South Carolina (Ravenel); Kentucky (Short); Louisiana (Hale); Missouri (Engelmann; Bush, 1891); Illinois (Engelmann; Hitchcock); Indiana; Michigan (Engelmann, Ontonagon; Schneck, 1881); Wisconsin (Trelease; Ballard, 666, 739, 1891, Waconia); Minnesota (Dewart, 1888; Dr. Mearns, 673, 674, 1888, Ft. Snelling; Sandberg, 1881, Vasa; Bailey, 151, 1886, Vermillion Lake; Oestland, 1886, Minnehaha; Ballard, 1891, 607, 731, 808, 830; Sheldon, 1892, 3061, 3256); S. Dakota (Williams, 1892); Iowa (Arthur; Hitchcock, 1890); Nebraska (Rydberg, 1887, 1890, Wahoo); Kansas (Pellet, 1890, Johnson Co.; Hitchcock, 1892, Medicine Lodge).

Form b. — Leaves large, 1 to 4 dm. long, the lobes from lanceolate to broadly ovate, apex obtuse, or abruptly acute, basal lobes acuminate, divaricate; scape simple or branched; bracts scarious, 5 to 10 mm. long, ovate, obtuse; achenium 3 mm. long with rather tumid dorsal wing, and long horizontal beak, subepidermal resin passages usually present on each face. — From Washington to Southern California.

Plants from central to southern California with very large leaves about as wide as long, and smooth, usually branched monoecious scape, form the *S. Chinensis* or *Sinensis* of Parish and other collectors, but are not synonymous with the Asiatic *S. Sinensis* Sims. The edible tubers are used by the Chinese.

Specimens of this examined were: 1367, Wilkes Exploring Expedition, 1838-1842, Sacramento Valley; Brewer, 2189, 1861, Pitt River, among the tules; Kellogg, near San Francisco; Jepson, 1891, Grand Island, Lower Sacramento R.; Parish, 2091, 1889 and 1893, San Bernardino, the latter probably introduced from farther north.

From northern California to Washington the common form has narrower rather coriaceous leaves, and dioecious scapes. The edible tubers,* (called Wappatoo), were formerly staple articles of commerce among the Indian tribes along the Columbia river and its tributaries.

Specimens of this examined from California (Moore, Grass Valley; Mrs. Austin, 1878, Plumas Co.); Oregon (E. Hall, 502, 1871; Collier, Eugene City); Washington (Drake and Dickson, 1883; Suksdorf, 673, 1885, — 2261, 1890, Kirkland; C. V. Piper, Seattle, 1892).

Form c.—Monoecious or dioecious; leaves 5 to 10 or 15 cm. long, the middle lobe ovate lanceolate or lanceolate, rounding to the acute apex, basal lobes narrower and often shorter, lanceolate, acute or acuminate and widely divergent; verticils few, 2 to 5; the short fertile pedicels about $\frac{2}{3}$ the length of the sterile; bracts ovate, acute, 5 to 10 mm. long; fruiting head about 15 mm. in diameter; achenium 2.5 to 3 mm. long. Phyllodia frequently present, either petiole like or flattened and linear lanceolate. This includes the varieties of *variabilis*: *hastata*, *angustifolia*, *gracilis* and *diversifolia* of most collectors.—Most abundant in the region of the Great Lakes and northwards. It ranges from Prince Edward Island to British Columbia and southward to New York, Kentucky and Nebraska. Immature or

* See History of the Exped. Lewis and Clarke, Revised and Abridged Ed. by A. M'Vickar, 2: 85, 103, 107, 171, 368 (1842). Hooker Fl. Bor. Amer. 2: 167 (1840).

phyllodial forms are difficult to distinguish from *S. arifolia* except by the longer style, and lateral beak of the achenium.

Specimens examined from Prince Edward Island (Macoun, 1888); New Brunswick (Chadborne, 1883); Quebec (Northrop, 1887, Detour du Lac, Lake Penniscouta); Vermont (Deane, 1885, Willoughby Lake; Rusby, 1892; Morong, 1885, Ferrisburgh, with lanceolate attenuate phyllodia 1 dm. long, and floating leaves 3 cm. long); New York (Engelmann, St. Lawrence River below Ogdensburg, with almost sessile staminate flowers; Sartwell, Penn Yan, with fertile pedicels only 5 mm. long; Clinton, Alexander's Bay, with floating lanceolate leaves 3 to 5 cm. long, and clustered lanceolate phyllodia; Engelmann, 1856, Table Rock, Niagara); Pennsylvania (Wolle, Bethlehem, the form *communis* of Engelmann); Ohio (Riehl, 1836); Kentucky (Rafinesque; Short, 1840); Michigan (Farwell, 419, 1886, and 460, 1890); Ontario (Macoun, 1873, Bay of Quinte, "*hastata* form c.;" Bell, 1878, Missinaiba River, "*hastata* form c".); Manitoba (Bourgeau, 1858, Lake Winnipeg; Macoun, 1884, Lake Winnipeg, *hastata* form b.); Minnesota (Pitcher; Wood, 1889; Ballard, 163, 331, and 897, 1891, and 1074, 1892; Sheldon, 921, 1891, Sleepy Eye, and East Battle Lake, 1892; Taylor, 642, 1891, Minnesota Lake); S. Dakota, (Duffey 1889); Nebraska (Rydberg, 1887, Wahoo, 1890, Lodge Pole Cr., 1891, Scotts Bluff and Deuel Counties, and 1533, 1812, 1893, Hooker Co.); Saskatchewan (Bourgeau, 1858); British Columbia (Macoun, 1889, mouth of Fraser River, "*hastata* form b.;" Lyall, 1858, 49th parallel, Oregon Boundary Survey).

Form d.—Monoecious, very slender, 20 to 25 cm. high; leaves 8 to 10 cm. long, the lobes narrowly linear, divergent; fertile pedicels 10 to 15 mm. long; verticils rather remote; fruiting head 1 cm. in diameter.—In the mountains, New York to New Hampshire.

Specimens examined from New York (Mrs. C. Van Brunt, 1886, Balsam Lake, Catskill Mts.; Torrey); Vermont (Dr. Chapman, Lake Dunmore); New Hampshire (Deane, 1883 and 1884, Shelburne, the *variabilis angustifolia* of S. Watson, but not of Engelmann).

Form e.—Monoecious, erect, 4 to 10 dm. high, with the habit of typical *latifolia*; lower leaves sagittate, the upper ovate-lanceolate, acute at both ends, the largest 10 cm. long and 4 to 5 cm. wide; achenium 3.5 mm. long, dorsally crested, with the beak somewhat recurved at the tip.—Collected by Dr. Engelmann on the American Bottoms, opposite St. Louis, in 1856. This form is the *S. variabilis*

diversifolia of Engelm. Specimens called *diversifolia* by collectors are, without exception, phyllodial or immature plants, from deep or running water, and belonging mostly to form *c*.

S. LATIFOLIA PUBESCENS (Muhl.) J. G. Smith, Mem. Torr. Bot. Club, Vol. 5: 25 (1894). *S. pubescens* Muhl. Cat. 86 (1813). *S. sagittifolia* var. *pubescens* Micheli in DC. Monog. Plan. 3: 69 (1881). *S. variabilis* var. *pubescens* Engelm. in A. Gray, Man. Ed. 5, 493 (1867).

Monoecious or dioecious, erect, 3 to 5 dm. high; leaves 7 to 15 or 25 cm. long, broadly ovate, rounding to the abruptly acute apex; bracts and sepals ovate, obtuse, pubescent or woolly; leaves, and especially the scape, from pubescent or woolly; leaves, and especially the scape, from pubescent or minutely hirsute to densely pubescent; scape often very slender; achenium 2 to 3 mm. long; fruiting head 8 to 15 mm. in diameter; fertile pedicels as long as or shorter than the sterile. — Ontario to Florida, from the mountains to the coast. There are three quite well marked forms. — Plate 8.

Form a. — Habit of form *a* of the species; leaves large, obtuse; achenium costate-angled, 3 mm. long. This undoubtedly represents Muhlenberg's type. — From Delaware northward.

Specimens examined from Ontario (Macoun, Bay of Quinte, 1877, very close to form *a* of the species, but with pubescent bracts); Pennsylvania (Darlington; Canby, Chester Co., 1863); Delaware (Canby, 1863).

Form b. — Leaves smaller, 7 to 15 cm. long, light green, sub-coriaceous; bracts and sepals densely pubescent; achenia 2.5 mm. long, smooth on the sides. — The common form in the mountains from Virginia southward.

Specimens examined from Virginia (A. H. Curtiss, 1871; Small, 1892; Britton and Vale, 1892); North Carolina (Rugel, 1842; J. D. Smith, 1881; McCarthy, 101, 1885; Boynton, 1888; Kofoid and Beardslee, 1891); South Carolina (Ravenel, 1869).

Form c. — Scape simple, slender, with the fertile pedi-

cels about equaling the sterile; leaves small, thin and papery in texture; pubescence less dense; achenia about 2 mm. long. Mature specimens have not yet been collected.—Georgia, Florida and Alabama.

Specimens examined from Georgia (Dr. Wray, Augusta); Alabama (C. Mohr, Montgomery and Mobile); Florida (Mary C. Reynolds, 1877, St. Augustine).

S. ENGELMANNIANA n. sp. J. G. Smith in Mem. Torr. Bot. Club. Vol. 5: 25 (1894). *S. variabilis* var. (?) *gracilis* S. Wats. in A. Gray, Man. Ed. 6, 555 (1889) in part, not Engelm.

Monoecious, slender, erect or ascending, 2 to 4 dm. high, glabrous; leaves 8 to 20 cm. long, the lobes linear, 1 to 5 mm. wide, apex rounded or acute, basal lobes acuminate; scape simple, striate, equaling the leaves; verticils 4 to 6, the lower fertile; bracts lanceolate, acute, 8 to 12 mm. long; flowers 2 to 3 cm. wide; petals white, rounded, entire, with a very short claw; sepals short, ovate, acute; stamens 18 to 25; pistils numerous, the style nearly twice as long as the ovary; pedicels slender, ascending, the fertile 10 to 14 mm., the sterile 10 to 20 mm. long; achenium narrowly obovate, 4 mm. long, the stout erect beak $\frac{1}{4}$ to $\frac{1}{3}$ the length of the achenium, entire-winged on both margins, with 1 to 3 strong lateral wings extending downward from the base of the beak on each side; fruiting head globose, 12 to 14 mm. in diameter.—Rare, in shallow ponds, from Massachusetts to Delaware and Florida (?). Dedicated to Dr. George Engelmann, by whom it was collected at Lake George, New York, in 1856.—Plate 9.

Specimens examined from Florida (?) (Chapman, in Herb. Columbia College); Delaware (specimens labeled *S. variabilis graminifolia*, in both the Engelmann and Bernhardt Herbaria); New Jersey (Diftenbaugh, 1864, Brown's Mills, labeled *S. variabilis gracilis*; Britton, 1889, Ocean Co. "*S. variabilis gracilis*"); New York (E. S. Miller, Wading R., Long Island); Massachusetts (Robbins, Sept. 1864, Uxbridge, the *S. variabilis gracilis* of many herbaria; Deane, 1888, Hyannis, and Barnstable; Sturtevant, 1890, S. Framingham).

S. LONGIROSTRA (Micheli) J. G. Smith in Mem. Torr. Bot. Club, Vol. 5: 26 (1894). *S. sagittifolia* var. (?) *longirostra* Micheli, in DC. Monog. Phan. 3: 69 (1881).

Monoecious, erect, 4 to 8 dm. high; leaves ample, smooth, 10 to 25 cm. long, middle lobe broadly ovate-rounded, abruptly acute; basal lobes ovate, acute; scape simple, exceeding the leaves, 6-angled below, 6 channeled above in fruit, and minutely scabrous on the angles; bracts 15 to 30 mm. long, triangular, acuminate; fertile pedicels ascending, 1 cm. long or less; pistils numerous, the curved style about twice the length of the ovary; achenium 4 mm. long, broadly obovate with a stout erect recurving beak, broadly winged on both margins, the ventral entire, the dorsal irregularly crenate, a single broken wing or crest on each face; fruiting head depressed globose, 12 to 18 mm. in diameter, subsessile. — Margins of ponds, from southeastern Pennsylvania and New Jersey to Alabama. This is the *S. variabilis echinocephala* of the Engelmann Herbarium.—Plate 10.

Specimens examined from Pennsylvania: (Wm. M. Canby, Aug. 1863, Delaware Co., and Oct. 1863, Chester Co.; T. P. James, 1848, West Philadelphia); New Jersey (James, 1848, near Camden); Delaware (Canby); Kentucky (Kearney, 187, Aug. 1893, Harlan County); Alabama (Drummond, a few flowers in the Engelmann Herbarium from the type specimen of the Kew herbarium).

* * * Achenium quadrate obovate, almost beakless; filaments longer than the anthers; basal lobes more than half the length of the leaf; bracts slightly connate.

S. LONGILOBA Engelm. in Torr. Bot. Mex. Bound. Surv. 212 (1858). *S. sagittifolia* var. *Mexicana* Mart. and Gal., Bull. Acad. Roy. Brux. 9: 379 (1842), not *S. Mexicana* Steud.

Monoecious, slender, erect, 3 to 5 dm. high; leaves 10 to 18 cm. long, the linear-lanceolate, tapering, acuminate basal lobes 2 to 3 times as long as the acute, linear to ovate-lanceolate middle one; scape simple or rarely branched; verticils 4 to 8, 1 to 3 lower ones fertile; bracts lanceolate, acuminate, 6 to 8 mm. long; fertile pedicels slender, diva-

ricate, 15 to 35 mm. long, exceeding the sterile; stamens 15 to 21; achenium 2 mm. long, narrowly winged on both margins and costate from the base of the beak above, sub-epidermal resin passages usually present; fruiting head 10 to 12 mm. in diameter; seed obovate, 1 mm. long, the seed-coat punctate. — Margins of shallow ponds, from western Kansas and eastern Colorado south to Texas, New Mexico and Sonora. — Plate 11.

Specimens examined from Kansas (Kellerman, Gove Co., 1885; Hitchcock, 1892, in Ford, Seward and McPherson counties); Oklahoma (Carleton, 262, 1891, Cherokee Outlet); Colorado (Fendler, 850, 1847, Arkansas R.; Beckwith and Gunnison, 49, Upper Arkansas R.); Texas (Lindheimer, June, 1847, Pierdenales; Wright, 680, and 1140, 1849); Mexico (Palmer, 1889, Lerdo, Sonora, specimens with winter tubers attached).

S. GREGGII n. sp.

Monoecious, stout, erect, 10 to 14 dm. high; leaves 20 to 40 cm. long, the lanceolate, acuminate, widely divergent basal lobes longer than the lanceolate or ovate and acuminate middle one; scape erect, 5-angled below, paniculately branched from the lowest verticils, exceeding the leaves; branches slender, striate, ascending; verticils numerous, the lower fertile; bracts lanceolate, acuminate, 15 to 25 mm. long; fertile pedicels 15 to 30 mm. long, about as long as the sterile; sepals minutely scabrous; stamens 30 or more, 4 to 5 mm. long; fruiting heads globose, 8 to 15 mm. in diameter; achenium 2 to 3 mm. long, tumid crested on both margins, from obovate with the ventral margin nearly straight to almost circular, edges acute, sides with an irregular saucer-shaped wing, and more or less tubercled; seed 1 mm. long, smooth. — In ponds and ditches, California and Mexico. Collected by J. A. Sanford, July 1893, Stockton, Cal.

The species is dedicated to Dr. J. Gregg, whose No. 833, collected in May 1849, at Zamora, Michoacan, Mexico, seems to be the same as our Californian plant. — Plate 12.

§§ *Fluitantes*: Leaves floating or submerged; fertile pedicel or pedicels thickened and reflexed in fruit, longer than the sterile; bracts at first

connate to the apex, and spathe-like; filaments dilated, bottle-shaped, not pubescent; anthers suborbicular.

S. SUBULATA (Linn.) Buchenau, Abh. Nat. Ver Bremen, **2**: 490 (1871). *Alisma subulata* L. Sp. Pl. 343 (1753). *S. pusilla* Nutt. Gen. **2**: 213 (1818). *S. natans* var. *lorata* A. Gray, Man. Ed. 5, 494 (1867), not Chapm.

Monoecious, with 1 or 2 flowers of the lowest verticil fertile, or all staminate; low, 5 to 15 cm. high, usually with rigid, obtuse or acutish phyllodia, or rarely with linear-lanceolate, subacute blades 2 to 3 cm. long, narrowing at the base into a spongy petiole; scape simple, equaled or exceeded by the leaves, few flowered; flowers rather large for the size of the plant, 15 mm. across; sepals ovate-lanceolate, obtuse; fertile pedicels 10 to 15 mm. long; bracts acute; stamens 7 or 8, less than 2 mm. long, the filaments equaling the anthers; achenia rather few, nearly 2 mm. long, 3-crested, with a short and slender, abrupt lateral beak and a short, fusiform resin passage down the middle of each face; fruiting head small.—In mud, tide-water flats from New York to Florida and Alabama.—Plate 13.

Specimens examined from New York (Sartwell; Torrey; A. Gray, Albany); Pennsylvania, New Jersey and Delaware, shores of the Delaware (Martindale; Conrad; Zanzinger, 1844; Durand, 1848; Tatnall, 1860; Austin, Hackensack; Smith, 1867); Maryland (Canby, Saulisbury, 1863; Porter, Port Dupont); District of Columbia (S. Watson, 1871; Seaman, 1872); Virginia (Dr. Robbins, shores of the Potomac; L. F. Ward, Custis Spring, 1877 and 1878); North Carolina (M. A. Curtis, 1843); Georgia (Baldwin); Florida (J. D. Smith, 1884, Magnolia, Clay Co.), Alabama (Charles Mohr, shores of Mobile Bay). Flowering from July to September.

S. SUBULATA NATANS (Michx.).—*S. natans* Michx. Fl. Bor. Am. **2**: 190 (1803). *S. natans* var. *lorata* Chapm., Flora S. U. S., 449 (1860).

Larger, submerged plant with ovate-oblong, elliptical, or subcordate, or truncate-hastate, floating leaves, with broader and longer flattened phyllodia; scape and pedicels elongated,

the flowers opening at the surface of the water or raised above it; bracts acuminate; fruiting head larger, 8 mm. in diameter; filaments longer; achenia more numerous, 2 mm. long, 5-to 7-crenately crested.—Flowering from August to October. In fresh water ponds and brackish tide waters along the coast from South Carolina to West Florida. Specimens from the coast of Florida have the petioles, phyllodia and floating scape much elongated, the latter often 8 to 10 dm. long. Figured from a specimen collected in West Florida by Dr. Leavenworth with both the floating leaves ascribed to *natans*, and the ribbon-like phyllodia of *lorata*. — Plate 13.

Specimens examined from "Carolina" (Bernhardi Herbarium); "Southern States" (Read, 1856; Baldwin); South Carolina (Ravenel, Santee Canal); Alabama (Mohr); Florida (Croom, 1835, Quincy; Dr. Chapman, 218, Apalachicola, and many specimens without date or locality in many herbaria; Dr. Leavenworth, at St. Marks, "where the water varies in depth with the tide from 2 to 5 or 6 feet," and Ft. Duane, East Florida; Keeler, Mayport and Jacksonville; and Curtiss, 2747, 1878, Jacksonville).

S. SUBULATA GRACILLIMA (S. Wats.) J. G. Smith, in Mem. Torr. Bot. Club, Vol. 5: 26 (1894). *S. natans* var. (?) *gracillima* S. Wats. in A. Gray, Man. Ed. 6, 556 (1890). *S. natans* Engelm. Bull. Torr. Bot. Club, 9: 4 (1882).

Submerged aquatic; leaves 6 to 12 dm. long, usually consisting of narrow flexuous phyllodia 2 mm. wide, indistinctly 1-nerved toward the apex, or widening into a 3-nerved, lanceolate blade 3 to 4 cm. long, 6 to 8 mm. wide; scape simple, terete or flattened, as long as the leaves, bearing 2 to 6 verticils; pedicels 3 to 10 cm. long; only 1 or 2 flowers appearing at the surface of the water at a time, 15 to 20 mm. across; inflorescence at length 4 to 5 dm. long; bracts acute, soon evanescent; the immature achenium broadly obovate, with a stout oblique beak. The achenia ripen under water and mature specimens have not yet been collected.—In deep water of streams in Eastern Massa-

chusetts and Rhode Island. Flowering late in July.— Plate 14.

Specimens examined from Massachusetts (Hitchings, July 22, 1870, Milton, and 1877, Readville; Boott, July 28, 1870, Readville; C. E. Faxon, July, 1877, Charles and Neponset Rivers, and 1882, Dedham; Edwin Faxon, 1891, Readville; Deane, 1890, Milton); Rhode Island (Collins, 1890, Ten Mile River).

S. FILIFORMIS n. sp.

Submerged aquatic, with linear, filiform phyllodia 1.5 to 6 dm. long, 2 to 3 mm. wide; scape slender, filiform, 6 to 12 dm. long, branching from all but the uppermost verticils; bracts lanceolate, acuminate, 3 to 5 mm. long, at length evanescent; pedicels and branches of the scape filiform, 4 to 10 cm. long; 1 or 2 flowers of the lowest verticil pistillate, the rest all staminate; verticils 6 to 10, remote; flowers 10 to 12 mm. wide; sepals ovate, obtuse, scarious margined; petals white; stamens 7; filaments over twice as long as the anthers; mature achenia not yet collected; ovary obovate, equaled by the slender oblique style. — Floating in still water, Dog River, Mobile County, Alabama, Mohr, August 14, 1893. One of the specimens is proliferous at the lowest verticil of the scape, throwing out roots, phyllodia and flowering pedicels from the axils of the bracts.— Plate 15.

More or less imperfect specimens of this are: Curtiss 31, Long Moss Spring, Jackson Co., and Jacksonville, Fla.; plants collected by Chapman, 1842, near Apalachicola; and by Keeler near Jacksonville. These were all distributed as *S. graminea*.

§ § § *Integrifoliae*. Leaves entire or hastate, from linear to ovate, neither sagittate nor floating; bracts free or connate at the base; stamens 12 or more; filaments slender, or dilated and pubescent.

* Fertile pedicels neither thickened nor reflexed in fruit.

— Achenium falcate, obovate, with an oblique beak; leaves lanceolate, entire, pseudo-penninerved; stamens more than 20; filaments slender as long as or longer than the linear oblong anthers.

S. LANCIFOLIA Linn. Amoen. 5: 409 (1760). *S. lancifolia* var. *major* Micheli, in DC. Monog. Phan. 3; 73 (1881).

Rigid, erect; leaves 4 to 9 dm. high, the blades coriaceous, 30 to 60 cm. long, 5 to 10 or 20 cm. wide, acute or long acuminate, 5- to 9-nerved, gradually narrowing to the base and decurrent into the petiole, pseudo-penninerved (the primary nerves separating from the thickened midrib above the base), scape erect, striate, branched, exceeding the leaves, often 1.5 to 2 m. high; verticils very numerous; fertile pedicels ascending, shorter than the sterile, 1 to 3 cm. long; bracts glabrous, free, ovate, acute or acuminate, 10 to 25 mm. long, before flowering enfolding the buds at the apex of the scape, with the free tips turned outward; flowers ample; sepals smooth; petals obovate, white; stamens numerous; anthers oblong, twisted after dehiscence, about as long as the cobwebby-pubescent filaments; staminodia present in the pistillate flower; achenium 2 to 3 mm. long, winged on both margins, a short vertical resin passage on each side; beak short.—From Florida (and Texas, *fide* Micheli) southward, throughout the West Indies, Mexico, Central and South America. Very variable as to its achenial characters, and the length of bracts and stamens.— Plate 16.

Specimens examined from Florida (Canby, 1869, Hibernia; Powell, 1872; Keeler, Jacksonville; Bates, 1889, Merritts Island; Simpson, 1890; Hulst, 1891, De Land; Curtiss, 2742, Jacksonville; Buckley; Burrowes).

S. LANCIFOLIA FALCATA (Pursh) J. G. Smith, in Mem. Torr. Bot. Club, Vol. 5: 25 (1894). *S. falcata* Pursh, Fl. Am. Sept. 397 (1814).

Rigid, erect, smaller than the species; leaves narrower, nerves 3 to 5; scape less branched, often simple; fertile pedicels shorter, 8 to 20 mm. long; bracts short, 5 to 8 mm. long, ovate, obtuse or sub-acute, more or less granular papillose on the back; filaments cobwebby pubescent, longer than the anthers; achenium about 2 mm. long,

winged on both margins, the resin passages more prominent.—From Delaware to Florida, Texas and Mexico.—Plate 16.

Specimens examined from Maryland (Canby, 1872, Saulsbury; Rusby, 1889, Stockton); Delaware (Canby, 1887, Seaford); Virginia (Rugel); North Carolina (McCarthy, 1885, Wilmington); South Carolina (Ravenel, Santee Canal); Carolina (Pursh, achenia from the type, in Herb. Engelmann, ex Herb. Hooker); Florida (Deane; Chapman, *Apalachicola*; Canby, 1879, *Hibernia*); Alabama (Mohr, 1879); Mississippi (Hilgard, 1859, sea coast marshes; Tracy, 2175, 1893, Biloxi); Louisiana (Lindheimer, 1839, Lake Pontchartrain; Dr. Hale); Texas (Lindheimer, 1842, Galveston Bay); Mexico (Rovirosa, 675, 1889). Many Mexican and Central American specimens have connate bracts, but are in other particulars identical with this variety.

S. AMBIGUA n. sp.—*S. lancifolia* Kellerman Anal. Flora Kansas, 178 (1888).

Erect, 3 to 6 dm. high; leaves lanceolate, long-acute, gradually narrowing to the base, not decurrent, 12 to 20 cm. long, 5-nerved; scape erect or ascending, simple or branching from the lowest whorl, equaling or exceeding the leaves; verticils numerous, 8 to 12 or more; bracts lanceolate, acuminate, connate at the base, sparsely papillose on the nerves, 10 to 15 mm. long; fertile pedicels ascending, 2 to 4 cm. long, longer than the sterile; stamens 20 to 25, the slender glabrous filaments longer than the oblong anthers; fruiting head depressed globose, 12 to 15 mm. in diameter; achenium 2 mm. long, narrowly falcate, almost beakless, very narrowly winged on both margins, the sides smooth, with 2 or 3 resin passages.—In ponds. Central Kansas and Oklahoma. Apparently first collected by Dr. Butler, 1875, in the Indian Territory. Also collected in McPherson Co., Kansas, by J. E. Bodin, July, 1887; and by A. S. Hitchcock, July 29, 1892, in fruit.

This species has been distributed as *S. lancifolia* but differs in having papillose, connate, lanceolate bracts, glabrous filaments, and almost beakless and wingless falcate achenia.—Plate 17.

+ + Achenium narrowly obovate, with a long, stout, erect beak; leaves hastate, veins free to the base; filaments dilated, pubescent; anthers short-oblong; fertile flowers subsessile.

S. RIGIDA Pursh, Fl. Am. Sept. 397 (1814). *S. heterophylla* Pursh, l. c. 396 (1814). *S. heterophylla* var. *angustifolia* Engelm. in A. Gray; Man. Ed. 5, 494 (1867), and var. *elliptica* Engelm. l. c. 494 (1867).

Monoecious, erect or ascending, 1 to 8 dm. high; leaves 5 to 20 cm. long, varying from elliptical, linear or lanceolate to broadly ovate, apex acute or abruptly rounded, base entire, or cordate, or with 1 or 2 narrow divergent lobes, veins 7 to 9; scape simple, weak, sinuous, at length decumbent, shorter than the leaves, usually geniculate at the lower verticil; bracts ovate, obtuse, 4 to 8 mm. long, deeply connate; 1 or rarely 2 verticils fertile, the pedicels not exceeding 1 cm. long; filaments usually exceeding the anthers; achenium narrowly winged on both margins, 3 to 4 mm. long, crested above; fruiting head echinate with the beaks of the achenia, 8 to 15 mm. in diameter, almost sessile.—In stagnant or running water, rooting in the mud. Quebec to Tennessee, west to Minnesota and Nebraska.—Plate 18.

Specimens differ greatly in size and form of leaf, differences depending largely on the habitat of the plant. When growing in deep pools or running streams, the petioles become thick, rigid and elongated, with long narrowly lanceolate spongy blades, or the tapering attenuate phyllodia are bladeless. This is the *S. heterophylla rigida* of the manuals and collectors. When growing in shallow ponds or in simply muddy places, the petioles are weaker, and the blade elliptical ovate and usually smaller, and the habit erect or ascending. This form is the *S. heterophylla elliptica* of collectors. Depauperate plants from shallow water or simply muddy places, with linear elliptical oblong leaves, are the *S. heterophylla angustifolia* of collectors. Toward the southern limit of its range, the plants are usually of ranker growth, with larger more often

hastately lobed leaves. In all these conditions there is much variation in form and size of achenium, stamen length, and in the size of the fruiting head. They occur together throughout the range and seem to be the result of different habitat, rather than to mark distinct forms or varieties.

Specimens examined from Vermont (Pringle, 1879; Faxon, 1882; Morong, 1885); New York (Dr. Pitcher, 1829; Sartwell, Penn Yan; Ward, 1879; Clinton, in the rapids above Goat Island, Niagara; Engelmann, 1840, 1856; Robbins, 1866; A. Gray); Connecticut (Wright); Pennsylvania (Porter; Guttenberg, 1879; James, 1860; Britton, 1889); New Jersey (James, 1848; Porter, 1860; Morong, 1891; Beyrich); Delaware (Tatnall, 1860); Ohio (Riehl, 1835, 1836; Engelmann; Riddell, 1868; Werner, 1887); Kentucky (Rafinesque); Tennessee (Gattinger, 1883); Illinois (Riehl, 1846; Engelmann, many dates and localities; Brendel, 1873; Eggert, 1877; Hitchcock, 1891; Bush, 1892); Iowa (Hitchcock, 1888); Nebraska (Williams, 1890; Smith, 1890; Rydberg, 1891; Bates, 1891, 1893, Sand Hills); Minnesota (Sandberg, 1885, 1890, 624 and 633, 1891; Herrick, 1878; Bailey, 542, 1886; Ballard, 273, 588, 814, 1891; Sheldon, 321, 1891, and 3149, 3211, 1892); Wisconsin (Houghton, 1831; Robbins, 1866); Michigan (Bigelow, 1865); Ontario (Macoun, 1868, 1884); Canada (Pursh).

+-+- Achenium obovate, with a short lateral beak; filament dilated at the base, pubescent; bracts connate, glabrous.

S. GRAMINEA Michx. Fl. Bor. Am. 2: 190 (1803). *S. acutifolia* Pursh, Fl. Amer. Sept. 397 (1814). *S. simplex* Torr. Comp. 356 (1826), not Pursh. *S. sagittifolia* var. *simplex* Hook. Fl. Bor. Amer. 2: 167 (1840). *S. Purshii* Kunth, Enum. 3: 160 (1841). *S. stolonifera* Engelm. and Gray, Boston Journ. Nat. Hist. 5: 234 (1847).

Monoecious or dioecious, 1 to 6 dm. high; leaves lanceolate to ovate elliptical, acute at both ends; or *very rarely* truncate or hastate with short divaricate lobes at the base, 1 to 6 cm. wide, 5 to 15 cm. long, 3- to 5-nerved, the nerves free to the base; scape simple, slender, erect, with few remote, or many verticils sometimes approximate; bracts ovate, acute, 3 to 5 mm. long, connate to the middle; fertile and sterile pedicels about equal, spreading, 1 to 3 cm.

long; stamens about 18; anthers exceeding or equaling the filaments; achenium 1.5 mm. long, dorsally crested and obliquely unicostate or winged on the sides, with or without subepidermal resin passages; fruiting head small, 5 to 10 mm. in diameter. Phyllodia, when present, flattened, linear lanceolate, acute, 8 to 30 cm. long, 1 to 2 cm. wide. Plants producing winter tubers and growing in tufts at the nodes of horizontal stolons.—In shallow ponds and marshes, or slowly running streams, or in simply muddy places. From New Foundland westward to the Missouri river, and south to Florida and Texas. In the southern portion of its range it passes into the next variety. — Plate 19.

Specimens examined from Canada (Michaux; Macoun, 1883, Cape Breton; Britton and Timmerman, 1889, L. Muskoka); New Brunswick (Macoun, Little Tobique River, 1884); New Hampshire (Deane, 1884, Shelburne); Massachusetts (Robbins, Uxbridge, 1865 and 1866; A. Gray, Newburyport, 1866; G. E. Stone, Worcester); New York (Dr. Sartwell, Penn Yan; A. H. Curtiss, Lake Oneida; J. A. Paine, Herkimer Co., 1854; Ward, South Bend, 1879; Vasey, Lake George, 1882; Morong, New York City, 1891); New Jersey (Durand; Bergen, 1845; Britton, Branchville, 1886); Delaware (Tatnall, 1860; Durand; Brinton, Townsend, 1890; James, 1867); Pennsylvania (Moser, Bethlehem, 1832; Wolle, Bethlehem, 1856; Porter, Harrisburg, 1863; James, Philadelphia, 1861 and 1867); West Virginia (Millsbaugh, Hinton, 1891); Michigan (Dr. Bigelow, Detroit, 1865); Ontario (Macoun, Petersboro Co., 1878); N. W. Terr. (Macoun, 208, Eagle Hills, 1879); South Dakota (Williams, Big Stone Lake, 1892); Iowa (Hitchcock, Consoforth, 1890); Nebraska (Swezey, 136, Hardy; Rydberg, Mead, 1890; Smith, Lincoln, 1890; Bates, Holt Cr., 1892); Kansas (Oyster, Paola, 1891); Missouri (Engelmann, many dates and collections, 1832 to 1880,—specimens collected at St. Louis in 1857 have the leaves truncate or divaricately hastate lobed at the base; Eggert, St. Louis, 1875; Pammel, Valley Park, 1886; Bush, Courtney, 1891; Jackson Co., 1892); Illinois (Engelmann, many dates and collections from 1832 to 1880; Meyer, East St. Louis, 1838; Vasey, Ringwood; E. Hall, Athens, 1861; Eggert, St. Clair, 1875; S. Watson, Quincy, 1885; Hitchcock, Fish Lake, 1890); Kentucky (Dr. Short, Lexington, 1835 and 1840), North Carolina (Schweinitz); South Carolina (Ravenel, Santee Canal); Georgia (Curtis, Atlanta 1850); Alabama (Mohr, Mobile, 1883, 1884); Southern States (Dr. Leavenworth; Dr. Walsh); Florida (Alden, Ft. King; Harding, Baker Co. 1887; Hulst, DeLand, 1891); Louisiana (Carpenter, 1839; Hale); Texas (Lindheimer, West of the Brazos, 1839, and 183, 1843 at Houston, *S. stolonifera* Engelm. and Gray, plants with linear lanceolate, acute acuminate phyllodia 1 cm. wide, 3 to 4 dm. long; Bigelow, San Bois, 1853;

Drummond, 434, 435 and 436; Dr. Bigelow, Whipple's Exped., Shawnee villages, 1853).

S. GRAMINEA CYCLOPTERA n. var.

Slender, erect, 2 to 8 dm. high, from a horizontal or oblique rhizome; leaves linear lanceolate, tapering gradually at both ends, or reduced to slender attenuate phyllodia; scape simple or branching from the lowest verticil; internodes longer than the fertile pedicels; bracts and stamens as in the species; achenium 1.5 mm. long, with an abrupt dorsal crest, an arched wing, and a median vertical resin passage on each side, or when maturing under water only costate or wrinkled.—From South Carolina to Florida and Louisiana.— Plate 20.

Specimens examined from South Carolina (Dr. Mohr, Nov. 1893, Ridgeland); Florida (Dr. Chapman, 234, in Herb. Torrey, and Apalachicola; Curtiss, 1876 and 2746, pine barren ponds, Duval Co.; Keeler, near Jacksonville); Alabama (Mohr, April, 1886, May, 1893, and Aug. 1893, Mobile); Louisiana (Hale, pine barren ponds, in Herb. Engelmänn).

S. GRAMINEA CHAPMANI n. var.

Three to five dm. high; leaves narrowly lanceolate, acute, tapering at base into the petiole, 2 to 3 cm. wide, 15 to 20 cm. long; scape weak, branched or simple, the fertile flowers numerous; bracts lanceolate, acute or acuminate, 6 to 12 mm. long, slightly connate at the base; stamens as in the species; fertile pedicels 1.5 to 3 cm. long; fruiting head 5 mm. in diameter; achenium almost beakless, 1 mm. long, with a narrow dorsal crest, the sides not costate nor winged. Phyllodia oblanceolate, long-acute, 1 to 2 cm. wide, 10 to 30 cm. long.—In creeks and stagnant ponds, West Florida and Alabama. Dedicated to the venerable southern botanist, Dr. Chapman, by whom it was first collected in 1862, “in a creek on the road to Marianna, 3 or 4 miles from Ochesee, West Florida.” Also collected by Dr. Mohr, 1880, and March, April, May and June, 1884, in the vicinity of Mobile, Alabama. — Plate 21.

S. CRISTATA Engelm. in Arthur's Contributions to the Flora of Iowa, no. 5, 3 (1882). Proc. Davenport Acad. Nat. Sci. 4: 29 (1886).

Monoecious, slender, erect, 30 to 75 cm. high, submersed or in shallow water; leaves linear-lanceolate or rarely elliptical lanceolate, 6 to 10 cm. long, 1 to 2 cm. wide, thick, spongy, triquetrous in cross section; petioles long and slender; scape simple, erect, the flowers at or above the surface of the water; verticils 4 to 6, the lowest fertile; bracts 5 to 7 mm. long, acute; fertile pedicels ascending, 1.5 to 3 cm. long; flowers about 2 cm. across; sepals ovate, obtuse, scarious tipped, rough on the veins; stamens about 24; filaments dilated subulate, pubescent at the middle, longer than the anthers; achenium 3 mm. long, dorsally crenately crested, ventral margin straight winged, an interrupted crenate crest on each side, beak short; fruiting head globose, 15 to 20 mm. in diameter. Often with tufted phyllodia, flat, linear lanceolate, acute, 1 dm. long. In deep water, the petioles and scape are spongy and rigid. The phyllodia grow from the nodes of the stolons along the muddy bottom, to the depth of 1 or 2 m. or more.—Ponds and lakes, northern Iowa, southern Minnesota and (?) western New York. Engelmann's type specimens were collected by R. I. Cratty, Emmett Co., Iowa, 1881.—Plate 22.

Specimens also examined from Minnesota (Sandberg, 623, Minnetonka, 1891; Herrick, 1878; Aiton, Minneapolis, 1891; Ballard, 603, Scott Co., 1891; Sheldon, 705, White Bear, 1891; Wood, Chub Lake, 1889); New York (?) Dr. Sartwell in Herb. Gray).

S. MACROCARPA, n. sp.

Monoecious, slender, 3 to 4 dm. high, suberect; phyllodia flexuous, 25 to 30 cm. long, gradually expanding above to a linear lanceolate blade 5 to 7 cm. long, 3 to 5 mm. wide; scape slender, equaling or exceeding the leaves, simple; verticils few, 3 to 5, about the length of the pedicels apart; bracts ovate, acute, 3 mm. long, connate; 1 to 3 flowers of lowest verticil perfect, their pedicels slender,

ascending, 6 to 12 mm. long; sterile pedicels 10 to 15 mm. long; stamens about 12, the dilated pubescent filaments a little longer than the short oblong anthers; fruiting head about 12 mm. in diameter; achenia oblong obovate, 3 mm. long, broadly winged on both margins, smooth or faintly unicastate, and with 2 or 3 resin passages on each side, beak short and oblique.—Margin of ponds in South Carolina. Collected by M. A. Curtis in South Carolina (Engelm. Herbarium). Related to *teres* and *cristata*.—Plate 23.

S. TERES S. Wats. in A. Gray, Man. Ed. 6, 555 (1890).

Monoecious, with acute, attenuate, terete, usually nodose phyllodia 10 to 30 cm. long, very rarely bearing a short linear blade; scape slender, erect, simple, 15 to 45 cm. high; bracts ovate, obtuse, 3 mm. long; verticils few, 1 to 3, 1 or 2 flowers of the lowest fertile; fertile pedicels slender, ascending, 10 to 25 mm. long, exceeding the sterile; flowers small, 12 to 15 mm. across; stamens 12, the filaments dilated, pubescent, shorter than the anthers; mature achenium rounded-obovate, 2 mm. long, with a short, erect beak, the ventral margin wing-angled, dorsal margin and sides crenately several- (7 to 11) crested; fruiting head 8 to 12 mm. in diameter.—In shallow water, Massachusetts to South Carolina. Mature achenia collected only by Walter Deane, at Hyannis, Massachusetts, August, 1888. The immature achenia are dark brown, and barely costate laterally. The fruits usually ripen under water, and do not then assume the same characters as when ripening above water.—Plate 24.

Specimens examined from Massachusetts (Farlow, 1881; Brewster); New York (E. S. Miller, Wading River, Long Island, 1871); New Jersey (Torrey, 1833, pine barrens). Specimens marked A, collected in North Carolina by M. A. Curtis, are intermediate between this species and *macrocarpa*. They have the habit of *teres*, but with larger achenium (2.5 mm.) with smooth sides, and more oblique beak.

+ + + + Achenium short obovate, with a short lateral beak; leaves lanceolate, entire; filament slender, glabrous; bracts connate, densely papillose.

S. PAPILLOSA Buchenau, Abh. Nat. Ver. Bremen, 1: 44 (1868). *S. lancifolia* var. *papillosa* (Buch.) Micheli, in DC. Monog. Phan. 3: 74 (1881).

Monoecious, slender, erect, 3 to 5 dm. high; leaves linear lanceolate, acute, gradually narrowing into the slender petiole, 10 to 15 cm. long, 3 to 5 nerved, pseudo-penninerved toward the base; scape very slender, erect, terete or obtusely 3-angled, striate, simple or branching from the lowest whorl; bracts obtuse, 3 to 4 mm. long, densely granular papillose on the back; fertile pedicels ascending, 1 to 2 cm. long, the sterile 1.5 to 3 cm. long; sepals ovate, obtuse, papillose; flowers 20 to 30 mm. across; stamens 18, about 3 mm. long, the linear oblong anthers equaled or exceeded by the slender glabrous filaments; achenium 1.5 mm. long, with a tumid dorsal crest and a single vertical resin passage on each face; fruiting head globose, 6 to 10 mm. in diameter. — In shallow ponds, Texas and Louisiana. — Plate 25.

This species was placed by Micheli as a variety of *lancifolia*, but is more closely related to *graminea* and perhaps *ambigua*. Fully matured achenia have not as yet been collected, or at least are not present in any of the American herbaria examined.

Specimens examined from Louisiana (Dr. Hale, Pine Barren, Alexandria); Texas (Drummond, 423; Lindheimer, Houston, 1842, a specimen with the foot of the plant bulbous, covered with the bases of the dead leaf sheaths, and 1843, 182; Elihu Hall, 623, 1872, Houston; G. C. Nealley, 1884, Beaumont). Lindheimer says of his Houston specimens that the successive annual tubers are formed one over another, so that a plant often has two or three of the old exhausted ones attached. The leaves are sometimes reduced to linear phyllodia which "resemble flowerless scapes."

* * Fertile pedicels thickened or reflexed in fruit.

+ Achenium obovate; leaves hastate or entire; bracts comate to above the middle, glabrous.

S. PLATYPHYLLA (Engelm.). *S. graminea* var. *platyphylla* Engelm. in A. Gray, Man. Ed. 5, 494 (1867); J. G. Smith in Mem. Torr. Bot. Club, Vol. 5: 25 (1894).

S. recurva Engelm. Patterson, Check-List, 130 (1887), name only.

Monoecious, erect, 2 to 5 dm. high; leaves subcoriaceous, 5 to 7 pseudo-penninerved from near the base, 5 to 15 cm. long, 2.5 to 9 cm. wide, broadly ovate, or ovate lanceolate, or ovate elliptical, obtuse or acute, abruptly short acuminate at the apex, rounding or gradually narrowing to the base, or rarely subcordate, auriculate or hastate; scape simple, rather weak, ascending, smooth, usually shorter than the leaves; 2 to 4 lower verticils fertile; fertile pedicels thick, divaricate in flower, weak and reflexed in fruit, 12 to 25 or rarely 40 mm. long, mostly longer than the sterile; bracts broadly ovate, 3 to 6 or 8 mm. long; flowers 2.5 to 3 cm. across; sepals ovate, obtuse, scarious at the tip; stamens about 21, the dilated pubescent filaments a little longer than the short oblong anthers; achenium 2 mm. long, obliquely obovate, winged on both margins, with a narrow dorsal crest, laterally with an oblique wing-angle extending downward from the base of the short horizontal or oblique beak; short resin passages usually present between the lateral angle and the crest; fruiting head 9 to 12 mm. in diameter; linear oblong or oblanceolate phyllodia, 10 to 15 mm. wide, 4 to 6 dm. long, often present.—In swamps and ponds from Texas to Mississippi and northward to the “sunken lands” of Southeast Missouri.—Plate 26.

Specimens examined from Texas (Lindheimer, 713, New Braunfels, 1847 and 1851; Reverchon, 1875, and “Curtiss, 2746 *” 1881, and 939, 1880, from Dallas; E. Hall, 624, Hempstead); Louisiana (Fendler, 1846, New Orleans; Dr. Hale, Alexandria and Bayou Robert); Mississippi (A. Wood, 1860); Arkansas (Eggert, 1893, Paragould); Missouri (Bush, 1893, Kennett, Dunklin Co.).

S. MEXICANA Steudel, Nom. 2: 491 (1841). *S. macrophylla* Zucc. in Abh. Kön. Bayr. Akad., 289 (1832), not Bunge; Micheli in DC. Monog. Phan. 3: 71 (1881). See below, p. 33.

This species is said by Micheli to be represented in the herbarium of

the St. Petersburg Academy, by a specimen collected by Dr. Engelmann at New Orleans. There is in Herb. Engelmann, a very long-pediceled specimen of *platyphylla* from Louisiana which has been mistakenly called *Mexicana*. This is undoubtedly the same as the plant in the St. Petersburg Herbarium. As far as known, *S. Mexicana* does not occur in the United States.

++ Achenium quadrate cuneate, beak short and triangular; leaves entire, pseudo-penninerved; bracts connate at the base.

S. SANFORDII, Greene, *Pittonia*, 2: 158, 1890.

Monoecious, 9 to 15 dm. high, rigidly erect or ascending; petioles rigid, 2 to 4 cm. thick at the base, obtusely triquetrous; blade linear lanceolate to oblong lanceolate, acute, tapering into the spongy petiole; scape simple, stout; bracts triangular, obtuse, 5 to 7 mm. long; verticils numerous, approximate, 2 to 3 lower ones fertile; fertile pedicels 15 to 20 mm. long, reflexed in fruit; sepals ovate, acute, 4 to 6 mm. long; stamens about 20, the oblong anther longer than the dilated glabrous filament; achenia numerous, 2 mm. long, winged on both margins, the sides reticulate, with or without a costate lateral angle; beak short, oblique, triangular; fruiting head 12 to 14 mm. in diameter. Triangular, alternate, spongy phyllodia several decimeters long are present when the plant is nearly or quite submerged. — Growing in the marshes along the lower San Joaquin River, California. Specimens examined from Stockton, Cal., collected by J. A. Sanford, 1891, and 1893. We are indebted to Mr. Sanford for fresh material of this species, and for water color habit sketches drawn under his direction by Dr. Hudson of Stockton. — Plate 28.

B. Fertile sepals erect and accrescent; pedicels of the pistillate flowers thickened and reflexed in fruit; petals cream white with a brownish purple spot at the base. Introduced species.

S. MONTEVIDENSIS Cham. and Schlecht. *Plant. Romanzoff. Linnaea* 2: 156 (1827). Micheli in DC. *Monog. Phan.* 3: 75 (1881).

Monoecious; petioles stout, rigid, erect, ascending; leaves sagittate, acute or obtuse, 1 to 5 dm. long and

broad, basal lobes acute, acuminate, widely divergent, glabrous above, sparsely scabrous on the nerves below; scape usually simple, stout, often 6 to 8 cm. in diameter at the base; verticils numerous, more or less approximate, 2 to 4 lower ones fertile; bracts connate at the base, lanceolate, long acuminate, the upper undeveloped portion of the scape appearing comose with their projecting tips; staminate pedicels slender, ascending, 20 to 30 mm. long, longer than the fertile; flowers large, the sepals broadly ovate, obtuse, 10 mm. wide, 15 mm. long; petals obovate, larger than the sepals; stamens very many, the narrow glandular pubescent filaments longer than the linear oblong anthers; achenia 2 to 3 mm. long, narrowly quadrate obovate, winged on both margins, with a short slender, oblique beak, and a prominent sub-epidermal resin passage on each side above; fruiting head large, 15 to 30 mm. in diameter.—A South American species established as a ballast plant in California and North Carolina. Specimens examined from California (J. A. Sanford, July 1893, Stockton); North Carolina (Gerald McCarthy, September, 1888). — Plate 29.

SPECIES FROM MEXICO.

§§ *Fluitantes*: stamens 12 or 13.

S. DEMERSA n. sp.

Submerged aquatic; the floating phyllodia linear attenuate, 2 to 6 dm. long, 10 to 15 mm. thick at the base, tapering gradually to the obtuse apex; scape simple, weak, rising to the surface of the water, usually 20 to 30 cm. long; bracts scarious, deeply connate, acute, 3 to 5 mm. long, soon evanescent; verticils 4 to 6, the lowest fertile; fertile pedicels thickened, 10 to 35 mm. long, at length reflexed; sterile pedicels slender, erect-spreading, 10 to 20 mm. long, the flowers at length deciduous, filaments dilated, glabrous, twice as long as the sub-orbicular anthers; fruiting head 5 to 6 mm. in diameter, sub-globose; acheneum obovate,

plump, 1.5 to 2 mm. long, with a very slender lateral erect beak, margins broadly winged below the middle, sides smooth; seed 1 mm. long, broadly obovate, striate. — Ponds near Guerrero, Chihuahua, Mexico, Pringle, 1367, Sept. 9, 1887. Distributed as *S. graminea* forma *acutifolia*. It is related to *S. subulata* and *S. filiformis*.— Plate 15.

§ § § Integrifoliae.

* Fertile pedicels neither thickened nor recurved in fruit.

S. LANCIFOLIA ANGUSTIFOLIA (Lindl.) Griseb. Catal. Pl. Cub. 218 (1866); Micheli, DC. Monogr. 3: 73. *S. angustifolia* Lindley, Bot. Reg. 14: pl. 1141 (1828).

Much smaller than the type in every part; blade of leaf very narrow or absent; bracts barely 3 mm. long; sepals 3 to 4 mm.; carpels crested,—ex Micheli, *l. c.* 73.—Ticaltepec, Mex., Liebmann, July, 1841, fide Buchenau, Engler's Bot. Jahrb. 2: 487.

* * Fertile pedicels thickened or recurved in fruit.

S. MEXICANA Steudel, Nomenclator, 491 (1841). *S. macrophylla* Zucc. Abhandl. Bayr. Akad. 1832, 289; Micheli, Monogr. 3: 71.—not Bunge, Mem. Sav. Etrang., 2: 137 (1831).—See above, p. 30.

Monoecious, 3 to 10 dm. high; erect, or the petioles weak and ascending; leaf 10 to 20 cm. long, 1 to 5 cm. wide, lanceolate, acute at the apex, entire, abruptly narrowing to the petiole, or hastate with small, nearly linear, divaricate lobes; veins free to the base; scape simple, erect, about equaling the leaves; verticils 3 to 5, remote; fertile pedicels erect-spreading in flower, 5 to 7 cm. long, exceeding the sterile; bracts broadly ovate, obtuse, 8 to 10 mm. long, connate nearly to the apex; flowers ample, 3 cm. across; stamens 21 to 30, 4 to 5 mm. long, the slender glabrous filaments longer than the oblong sagittate anthers. The mature achenia have not yet been collected. In immature fruiting heads, the ovaries are broadly winged,

with a long horizontal style, and an undulate dorsal crest.—
Plate 27.

Specimens examined from Mexico, collected by L. Hahn, 1869, in Herb. Engelmann, ex Herb. A. Braun; and a fragment from the type, in Herb. Engelmann, ex Herb. Monaco, collected by Karwinsky.

LOPHOTOCARPUS T. Durand, Index Gen. Phan. 627 (1888). *Lophiocarpus* Miquel, Ill. Fl. Arch. Ind. 1: part 2, 50 (1870), not Turcz.—Fertile flowers with stamens; filaments hypogynous.

L. CALYCINUS (Engelm.) J. G. Smith, in Mem. Torr. Bot. Club, Vol. 5: 25 (1894).—*Sagittaria calycina* Engelm. including var *maxima*, var *media* and var. *fluitans* Engelm. in Torr. Bot. Mex. Bound. Surv. 212 (1858); *S. calycina* var. *spongiosa*, and *S. calycina* var. *grandis* Engelm. in A. Gray, Man. Ed. 5, 493, 494 (1867); *Lophiocarpus calycinus* Micheli, in DC. Monog. Phan. 3: 61 (1881).

Weak; leaves floating or ascending, halberd shaped, broader than long, or sagittate, hastate or entire, varying greatly, from 2 to 20 cm. long by 1.5 to 30 cm. wide, obtuse or acutish, the basal lobes widely divaricate, ovate, acuminate; scape simple, 1 to 3 dm. high, weak, at length decumbent; bracts short, orbicular, obtuse, those at the base of the staminate verticils often lanceolate, pointed; fertile pedicels greatly thickened, reflexed, as long as or much longer than the more slender sterile ones; filaments slightly roughened; achenia obovate, 2 mm. long, narrowly winged on both margins, a very short resin passage at the base of the beak above, beak about $\frac{1}{4}$ as long as the achenium, triangular, horizontal. A very variable species according to the habitat; petioles and scapes rather spongy, as are the phyllodia when present; phyllodia sometimes strongly nodose.—From New Brunswick to S. Dakota and California, and southward.

Specimens examined from New Brunswick (Fowler, Bass R., Kent Co., July, 1870); Maine (Swan, Kennebeck, Sept. 1859); Massachusetts

(Boott, Woburn Pond, 1863); New Jersey (Parker, Camden, Oct. 1877; Austin, Hackensack R., Aug. 1861); Delaware (Tatnall, Wilmington, 1861); Virginia (Coville, Colonial Beach, July 1890); Michigan (Schneck, Grand Rapids, 1880, 1881); Wisconsin (Hale, Prairie du Chien, 1861); Illinois and Missouri, many collections, 1842 to 1893; S. Dakota (Williams, 3, 5, 7 and 14, 1892); Nebraska (Williams, Greenwood, 1890); Kansas (Hitchcock, Manhattan, 1892); Indian Terr. (Palmer, 331, False Wichita R. 1868; Carleton, 268, Cherokee Outlet, 1891); Louisiana (Hale, Alexandria); Texas (Wright, 679; Oct. 1849); New Mexico (Wright, 1899, 1852); California (Parish, 1136, Los Angeles Co., Oct. 1881; Sanford, Stockton, July, 1893).

L. GUYANENSIS (HBK.) Micheli, Monogr. 3: 62 (1881).
Sagittaria Guyanensis HBK. Nov. Gen. Sp. 1: 250 (1815).

Leaves floating, broadly ovate, deeply cordate, 3 to 5 cm. long by 4 to 6 cm. wide, obtuse to slightly emarginate; scape erect or flexuous procumbent; bracts broadly ovate, obtuse; pedicels scarcely exceeding the bracts; filaments somewhat glandular; achenia very numerous, flattened, deeply notched, winged on both margins, without resin passage, the beak scarcely surpassing the margin.—Mexico, etc., fide Micheli, *l. c.* 63.

EXPLANATION OF PLATES ILLUSTRATING THE NORTH AMERICAN SPECIES OF SAGITTARIA.

The figures were drawn, under the supervision of the author, by Miss Grace E. Johnson. Nos. 3, 28, and 29, are from living plants. No. 28 is reduced from a water color sketch drawn under Mr. J. A. Sanford's supervision by Dr. Hudson of Stockton, Cal. No. 2 is from the original plate published in the Bull. Torr. Bot. Club (1893), kindly loaned by Dr. N. L. Britton. The remainder are from herbarium specimens. Detail drawings, unless otherwise specified, are enlarged ten diameters.

Plate 1, *S. arifolia* Nutt.—1, Plant reduced to half size; 2 and 3, lateral view and cross section of achenium; 4 stamen; 5, plant of *S. arifolia stricta*, reduced to half size.

Plate 2, *S. cuneata* Sheld.—Plant and upper portion of the scape, natural size; achenium, $\times 30$.

Plate 3, *S. latifolia* Willd. — 1, Plant reduced one-fourth; 2, portion of a branching scape, reduced to half size; 3, 4, achenia; 5, cross-section of achenium; 6, fruiting head, natural size; 7, stamens from the same flower.

Plate 4, *S. latifolia*, Willd., forms *a* and *b*. — 1, fertile scape, reduced to half size; 2, sterile scape, reduced to half size; 3, achenium, form *a*; 4, achenium, form *b*, from Washington; 5, achenium, form *b*, from S. California; 6, achenium of *S. Sinensis* Sims, ex herb. Hooker.

Plate 5, *S. latifolia* form *c*. — 1, Plant, reduced to half size; 2, achenium; 3, cross-section of achenium; 4, seed.

Plate 6, *S. latifolia* form *d*. — 1, Plant, reduced to half size; 2, achenium; 3, seed.

Plate 7, *S. latifolia* form *e*. — 1, Plant, one-fourth natural size; 2, achenium; 3, cross-section of achenium.

Plate 8, *S. latifolia pubescens* (Muhl.). — Form *a*: 1, leaf, one-half size; 2, achenium; 3, stamen; 4, fruiting head, natural size; details after Engelmann. — Form *b*: 5, plant, three-eighths natural size. — Form *c*: 6, scape, natural size; 7, immature achenium; 8, stamen.

Plate 9, *S. Engelmanniana*. — 1, Plant, one-half size; 2, achenium; 3, cross section of achenium; 4, pistil; 5, stamen; 6, leaf, natural size.

Plate 10, *S. longirostra* (Micheli). — Details after Engelmann. 1, plant, one-third size; 2, leaf, one-half size; 3, achenium; 4, cross section of achenium; 5, immature achenium from Drummond's type collection; 6, young fruiting head, natural size; 7, pistil; 8, stamen; 9, and 10, cross sections of scape, below and above. Sketches, except no. 4, made from Canby's specimens.

Plate 11, *S. longiloba* Engelm. — 1, Plant, one-third natural size; 2, winter-tuber, with young plant; 3, achenium; 4, cross section of achenium; 5, seed; 6, stamen.

Plate 12, *S. Greggii*. — 1, Plant, one-sixth natural size; 2, leaf, one-half natural size; 3, achenium; 4, stamen.

Plate 13, *S. subulata* (L.) Buch. — 1, Plant, natural size; 2, achenium, lateral and 3, dorsal view; 4, stamen. *S. subulata gracillima* (S. Wats.). — 5, Plant, natural size; 6, inflorescence; 7, immature achenium; 8, stamen.

Plate 14, *S. subulata natans* (Michx.) — 1, Plant, one-half size; 2, achenium, lateral and 3, dorsal view; 4, stamen.

Plate 15, *S. demersa*. — 1, Plant, one-half natural size; 2, achenium; 3, stamen; 4, leaf, one-half natural size. *S. filiformis*. — 5, Plant, one-half natural size; 6, pistil; 7, stamen; 8, bracts, \times 5.

Plate 16, *S. lancifolia* L. — 1, Plant, one-sixth natural size; 2, achenium. *S. lancifolia falcata* (Pursh). — 3, Part of scape, natural size; 4, achenium; 5, stamen.

Plate 17, *S. ambigua*. — 1, Plant, one-third size; 2, achenium; 3, stamen; 4, bracts, natural size.

Plate 18, *S. rigida* Pursh. — 1, Plant, one-half size; 2, 3, leaves, one-half size; 4, achenium; 5, cross section of achenium; 6, stamen.

Plate 19, *S. graminea* Michx. — 1, Plant, one-half size; 2, leaf, natural size; 3, achenium, lateral and 4, dorsal view; 5, seed; 6, stamen.

Plate 20, *S. graminea cycloptera*.—1, Plant, one-half natural size; 2, achenium; 3, cross section of achenium; 4, stamen; 5, bracts, $\times 2$.

Plate 21, *S. graminea Chapmani*.—1, Plant, one-third natural size; 2, achenium; 3, stamen; 4, bracts, natural size.

Plate 22, *S. cristata* Engelm.—1, Plant, one-third natural size; 2, achenium, lateral and 3, dorsal view, 4, cross-section; 5, stamen, ripe and 6, effete.

Plate 23, *S. macrocarpa*.—1, Plant, one-half size; 2, achenium; 3, stamen.

Plate 24, *S. teres* S. Wats.—1, Plant, one-half size; 2, stolon, natural size; 3, achenium, lateral view and 4, in cross section; 5, stamen.

Plate 25, *S. papillosa* Buch.—1, Plant, one-fourth size; 2, achenium; 3, stamen; 4, bracts, $\times 6$.

Plate 26, *S. platyphylla* (Engelm.)—1, Plant, one-half size; 2, achenium; 3, stamen; 4, fruiting scape, one-half size; 5, 6, leaves, one-half size.

Plate 27, *S. Mexicana* Steudel.—1, Plant, one-third natural size; 2, immature achenium; 3, stamen from bud; 4, stamen.

Plate 28, *S. Sanfordii* Greene.—1, Plant, one-third natural size; 2, achenium; 3, stamen; 4, leaf, one-half natural size.

Plate 29, *S. Montevicensis* Cham. and Schl.—1, Plant, one-fourth natural size; 2, achenium, lateral view and 3, cross-section; 4, stamen; 5, staminate flower, one-half natural size.

INDEX TO SPECIES OF SAGITTARIA.

The references are to the subpagination of the article. Synonyms are in parenthesis.

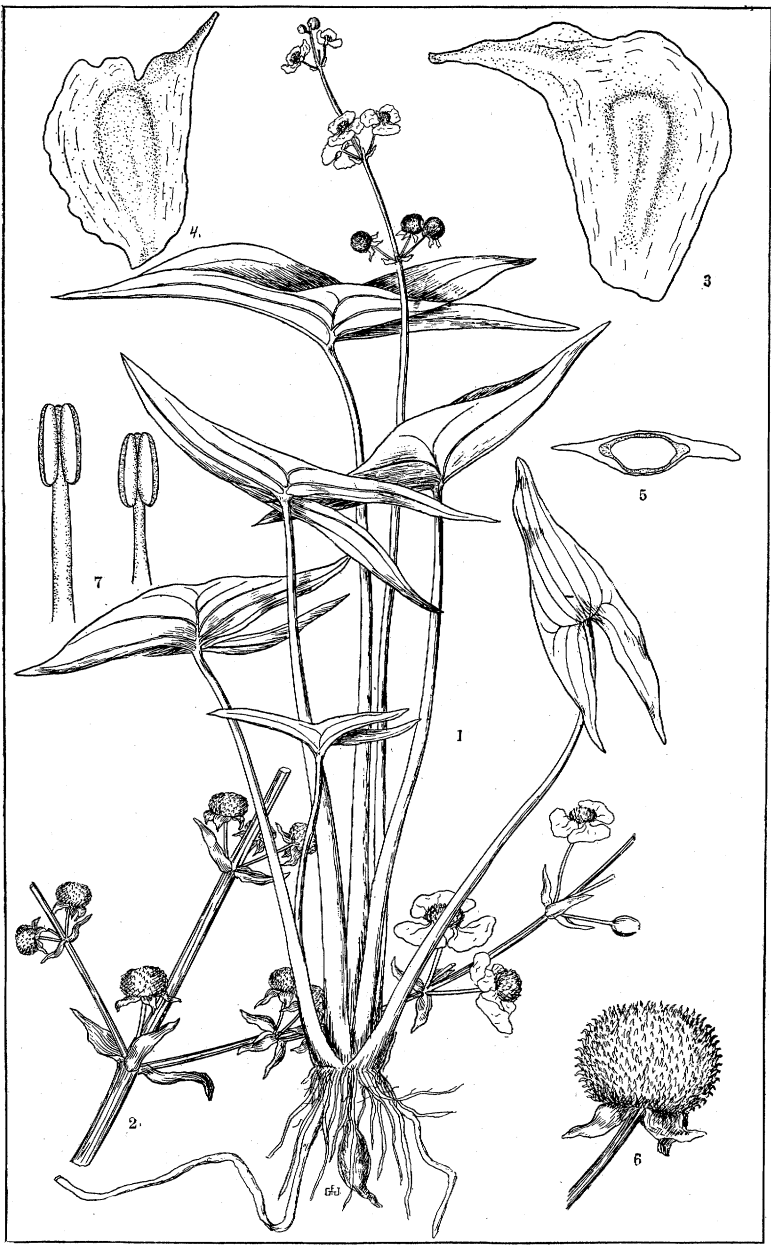
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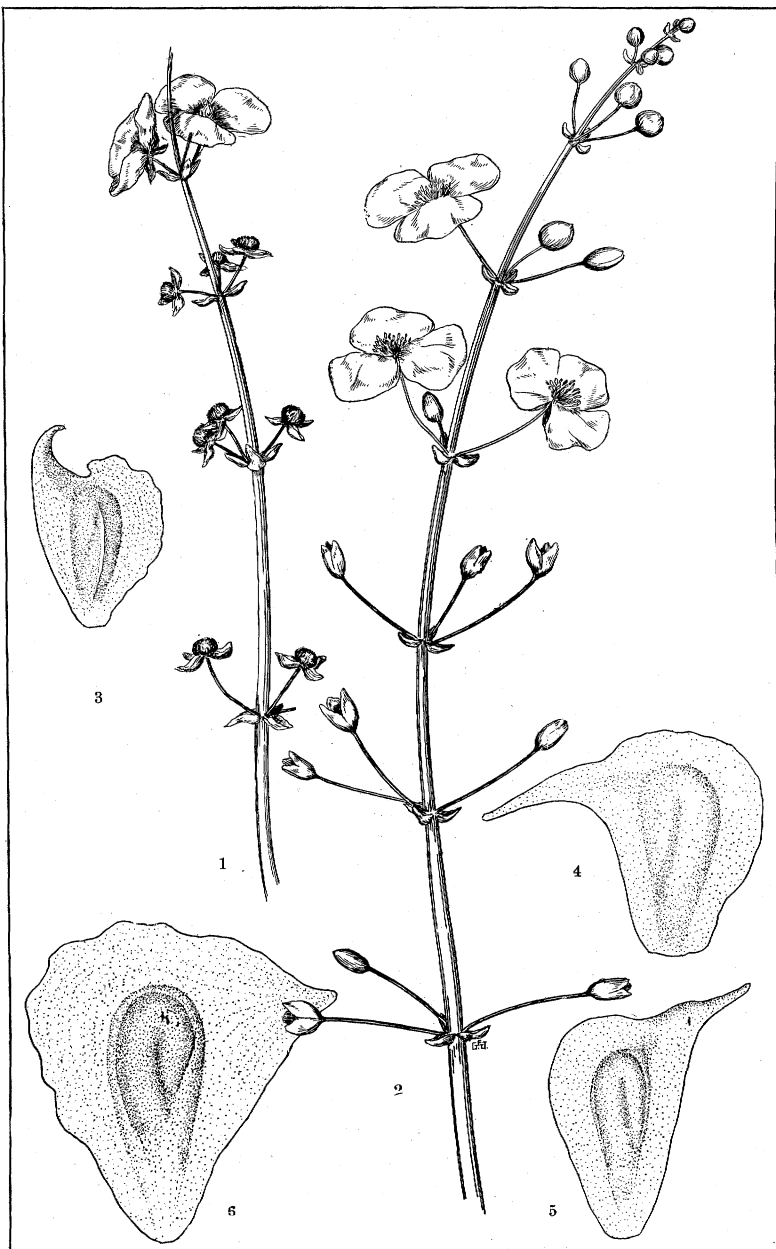
SAGITTARIA ARIFOLIA and var. STRICTA.



SAGITTARIA CUNEATA.



SAGITTARIA LATIFOLIA.



SAGITTARIA LATIFOLIA, *a* and *b*, and *S. SINENSIS*.



SAGITTARIA LATIFOLIA, c.



SAGITTARIA LATIFOLIA, *α*.



SAGITTARIA LATIFOLIA, e.



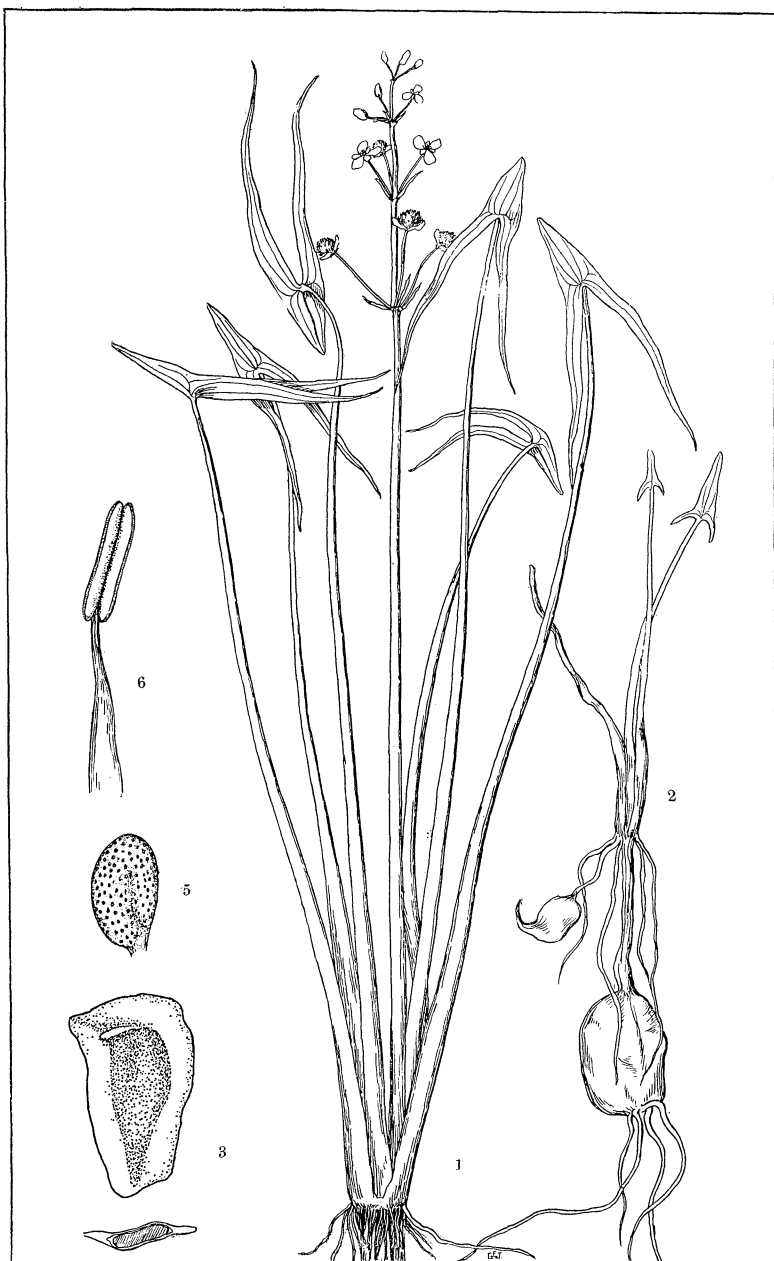
SAGITTARIA LATIFOLIA, PUBESCENS.



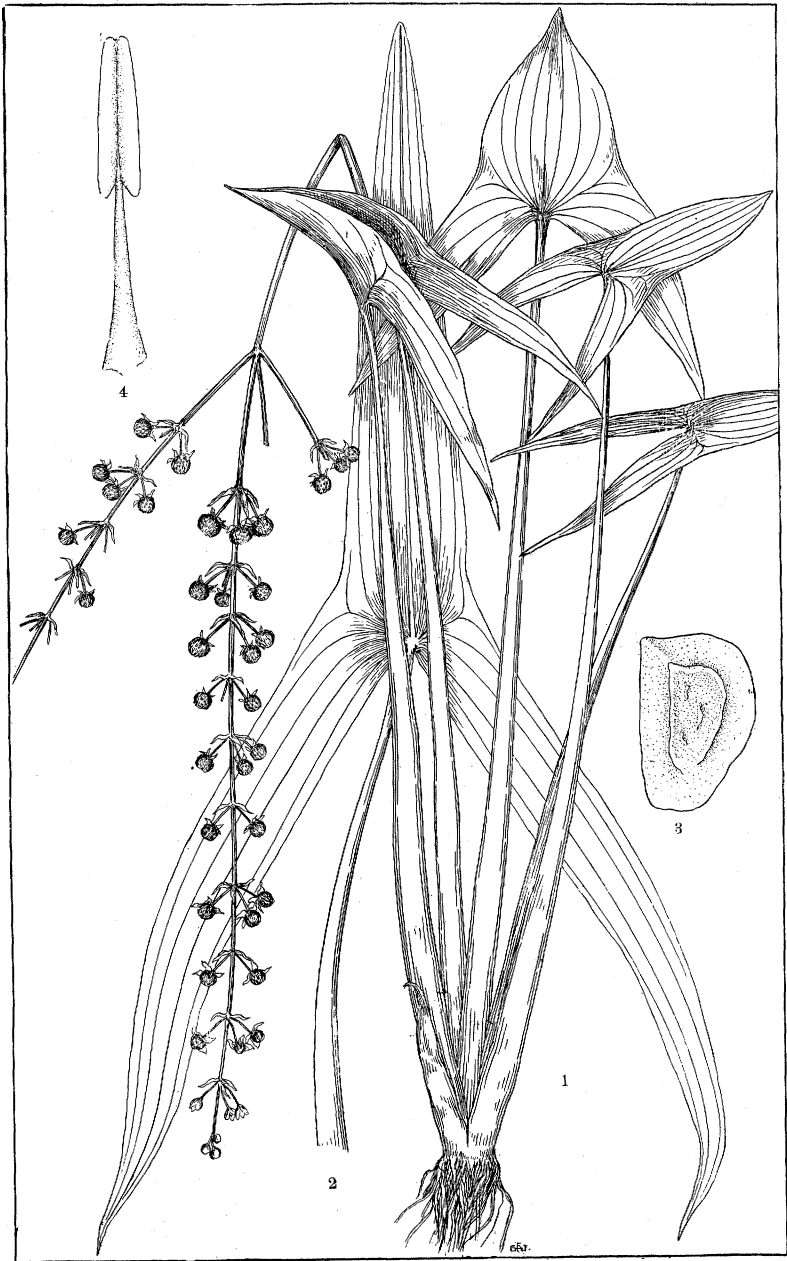
SAGITTARIA ENGELMANNIANA.



SAGITTARIA LONGIROSTRA.



SAGITTARIA LONGILOBA.



SAGITTARIA GREGGII.



SAGITTARIA SUBULATA and var. GRACILLIMA.



SAGITTARIA SUBULATA, NATANS.



SAGITTARIA DEMERSA and S. FILIFORMIS.



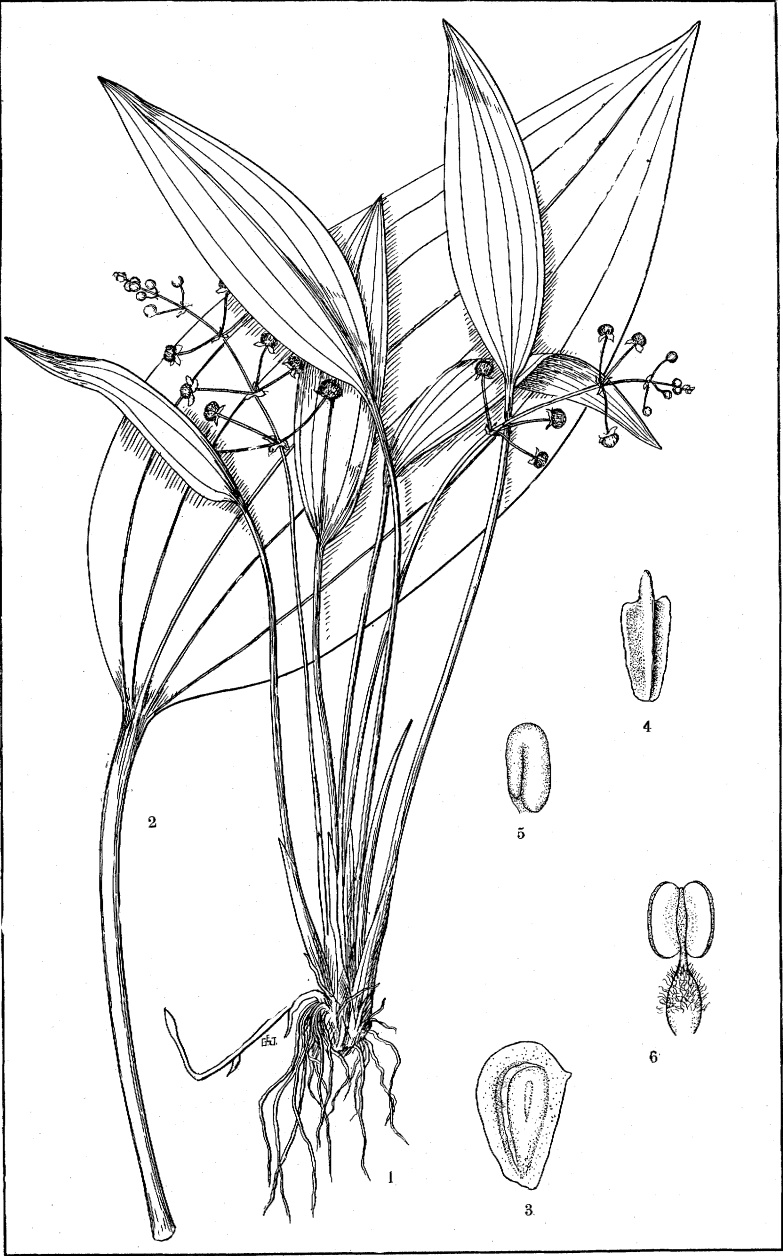
SAGITTARIA LANCIFOLIA and var. FALCATA.



SAGITTARIA AMBIGUA.



SAGITTARIA RIGIDA.



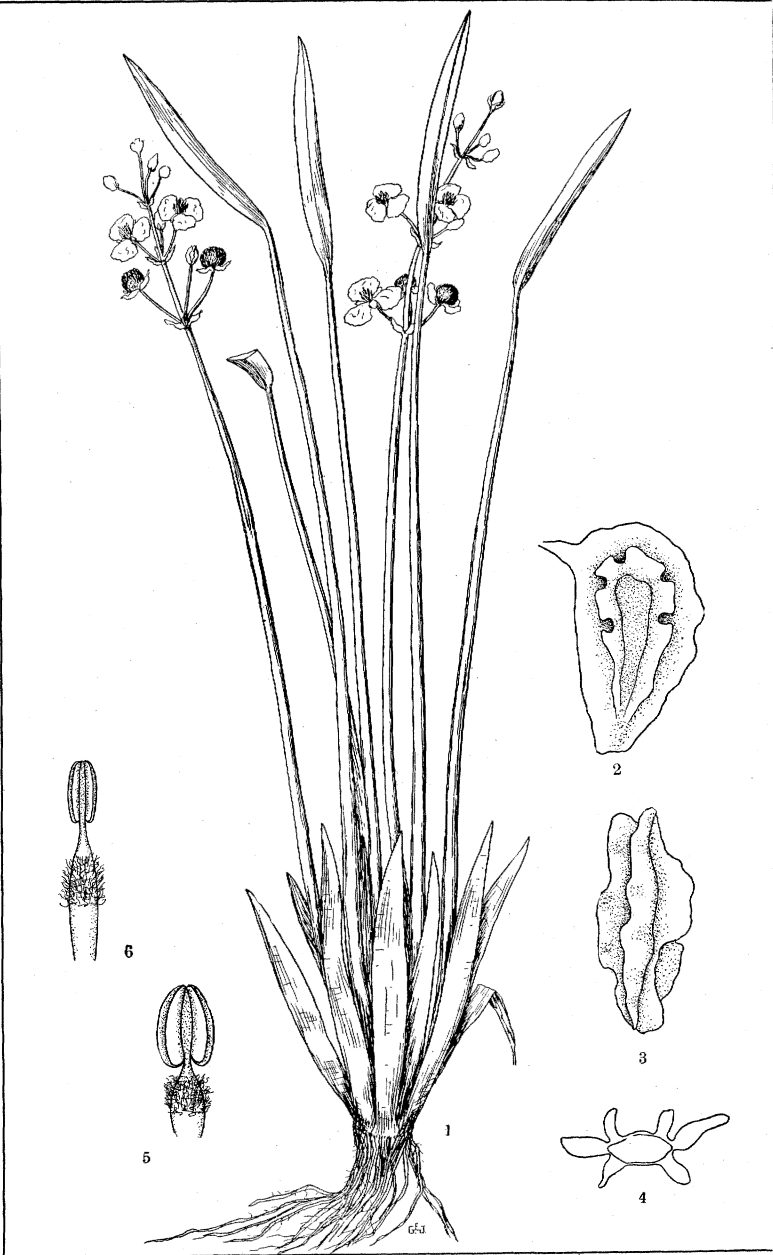
SAGITTARIA GRAMINEA.



SAGITTARIA GRAMINEA CYCLOPTERA.



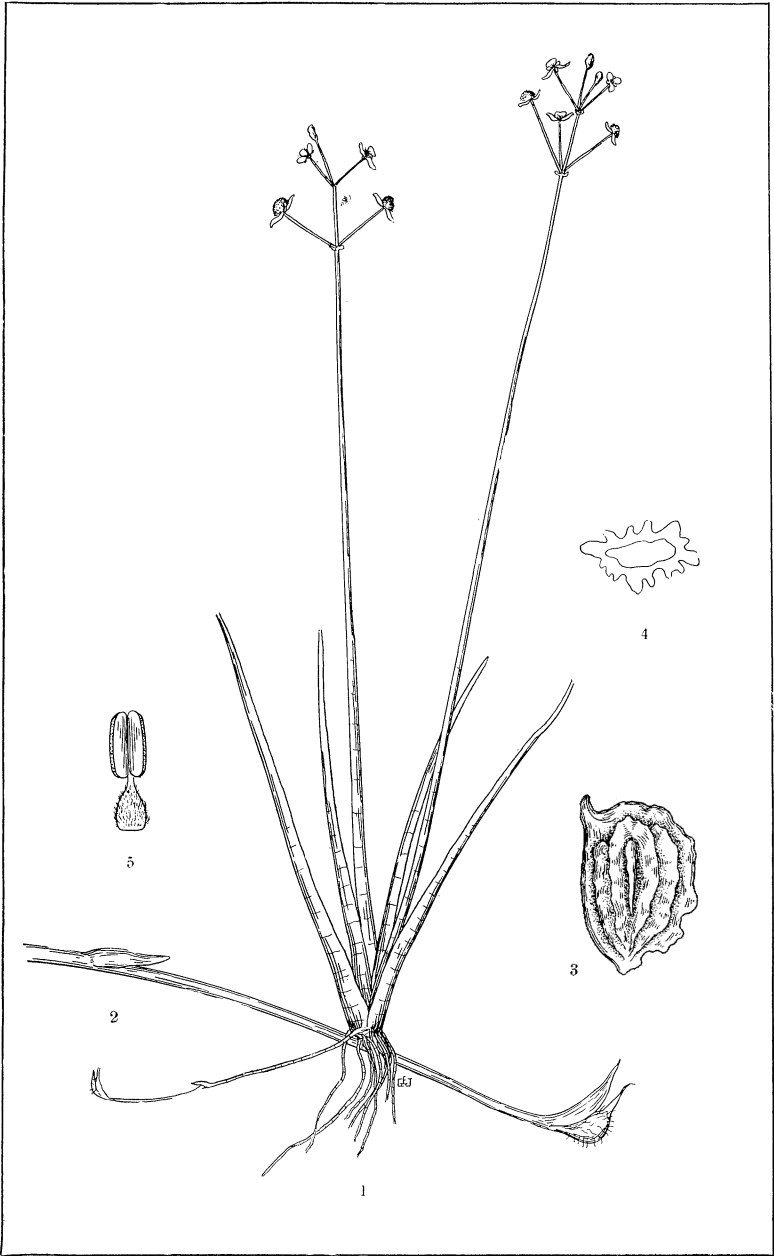
SAGITTARIA GRAMINEA CHAPMANI.



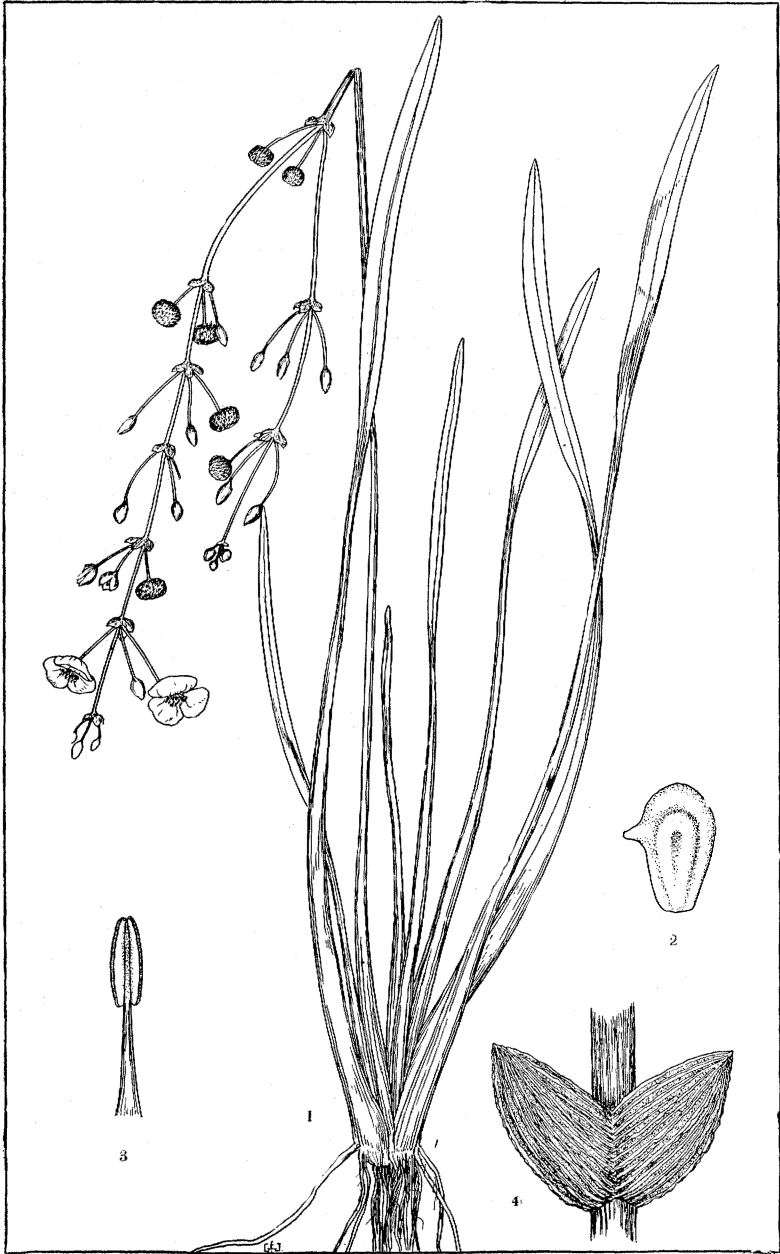
SAGITTARIA CRISTATA.



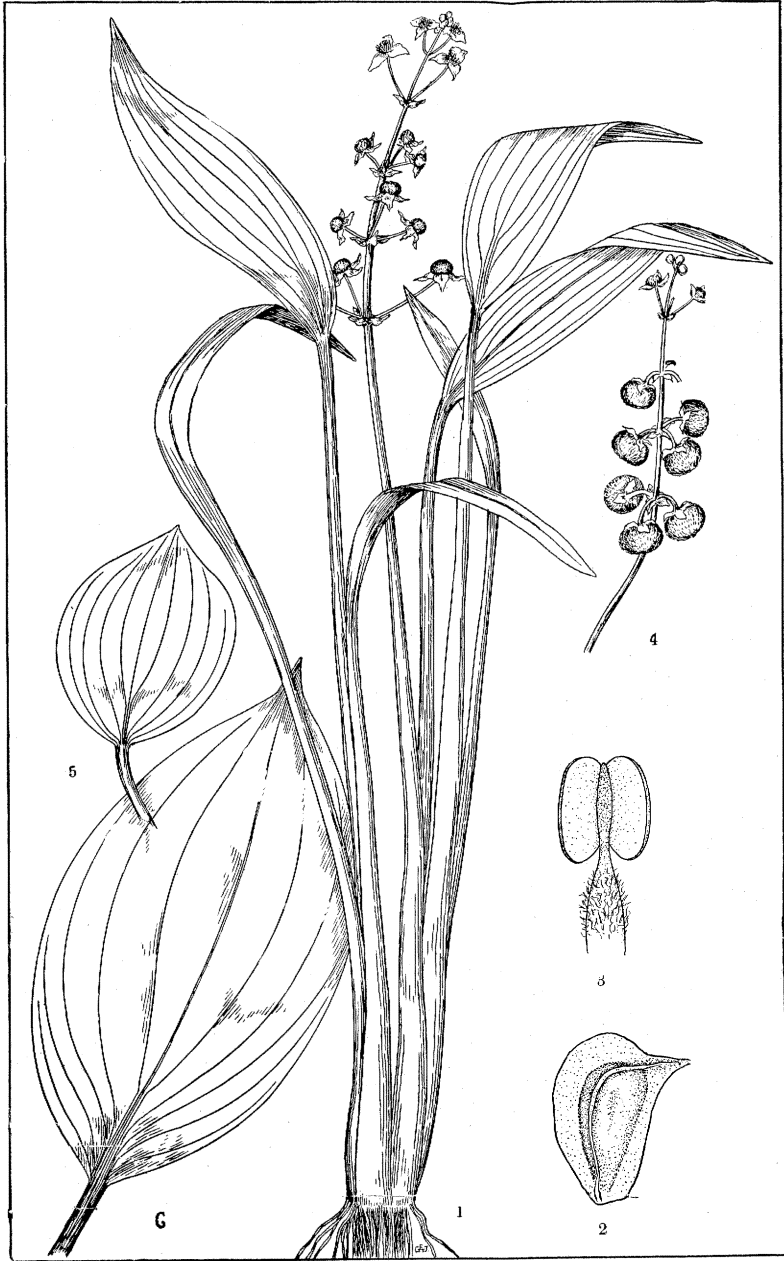
SAGITTARIA MACROCARPA.



SAGITTARIA TERES.



SAGITTARIA PAPILLOSA.



SAGITTARIA PLATYPHYLLA.



SAGITTARIA MEXICANA.



SAGITTARIA SANFORDII.



SAGITTARIA MONTEVIDENSIS.